FILE CODE 120-A-6
August 1978

GRADING MANUAL

HOW TO USE

THE

CUMULATIVE SUM SAMPLING PLAN (CUSUM)

(*for attributes standards only*)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOOD SAFETY AND QUALITY SERVICE
FRUIT AND VEGETABLE QUALITY DIVISION
PROCESSED PRODUCTS BRANCH

120-A-6
August 1978

This manual is designed for Processed Products Branch personnel of the U.S. Department of Agriculture. Its purpose is to give background information and guidelines to assist in the uniform application and interpretation of U.S. grade standards, other similar specifications and special procedures.

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I N D E X

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STATISTICAL EXPLANATION OF ON-LINE SAMPLING PROCEDURES

A "lot" is never formed under an on-line inspection situation. Instead, production is divided into separate portions (e.g., tote bins, period codes, subcodes, etc.). Each portion is inspected and assigned a grade as it is produced. The grade is final. This procedure frees the producer to ship directly off the line. The *Cumulative Sum (CuSum) Sampling Plan* was developed to handle on-line inspection.

CuSum is designed to maintain a constant good quality, rather than to screen out poor quality after it has been produced. Therefore, the producer is requested to establish the desired quality level for production. CuSum will tell only whether the production meets or fails the intended grade. It is not structured to discern between different quality levels.

The producer is provided with step-by-step reporting as each sample unit is graded. This information may be used to help the producer control the process. Positive CuSum values (in excess of zero(0)) provide evidence of worsening quality. This signals the the need for improvement. The ability to abuse the CuSum sampling plan by intentionally producing poorer quality, after extablishing a history of good quality, is limited.

1. *CuSum sampling plans.* A CuSum sampling plan is defined by three numbers, denoted by the letters "T," "L," and "S." These values are chosen for each AQL and sample unit size to pass 95 percent of the production produced at the AQL. Individual portions of production will have, at most, a 98 percent to 99.5 percent chance of passing when the CuSum value is zero (0).

2. *Sample unit tolerance ("T").* The "T" value is the sample unit tolerance. A portion of production represented by a sample unit having "T" or less defects will always pass the intended grade. Only the number of defects that exceed "T" are counted and accumulated by the CuSum plan. If the number of defects is less than "T," the CuSum accumulation will be decreased.

STATISTICAL EXPLANATION OF ON-LINE SAMPLING PROCEDURES (continuation)

3. *Acceptance limit ("L").* Some sample units may have more than "T" defects, even though the producer has good quality. This will occur due to sample variation. However, when the CuSum value exceeds "L," the production quality is probably below the intended grade. Only those portions of production represented by sample units whose CuSum value exceeds "L" are rejected for the designated grade.

   There may be portions of production with good quality that fail the designated grade. This risk will be present with *any sampling plan* because of sampling variation. Also, poor production may be passed for the intended grade because our sample information does not provide sufficient proof that the quality is poor. This is also due to sampling variation.

4. *Starting value ("S").* At the start of a CuSum value, no prior information is available about the production quality. To give production approximately a 95 percent chance of passing at the start of each plan, the CuSum value is set equal to "S." Starting the CuSum value at any value other than "S," would make the sampling plan either too tight or too loose for the first portions of production produced at the AQL.

   CuSum sampling plans are designed to be continuous sampling plans with infrequent restarts. There is no need to restart a CuSum sampling plan unless there is a distinct break in production or a redesignation of the grade. A CuSum sampling plan does not necessarily need to be restarted at the beginning of each shift or each day's production.

5. *Resetting to zero (0).* Whenever the CuSum value is less than zero, it is reset equal to zero. This rule prevents the build up of too much good history, which would permit the acceptance of poorer quality later in a production run. If negative CuSum values were maintained, the number of defects that would be permitted in subsequent sample units, would be large. There is no specific absolute limit (AL) given for any individual sample unit by the CuSum sampling plan. By always resetting to zero (0), when the CuSum is negative, the maximum allowance for any sample unit becomes "T" plus "L."

STATISTICAL EXPLANATION OF ON-LINE SAMPLING PROCEDURES (continuation)

6. *Resetting to "L."* The CuSum value is reset to "L," when it exceeds "L." This requires the next sample unit to meet the tolerance ("T" or less defects) for production to pass the designated grade. By resetting to "L," the producer is also assured that all portions of production will pass the designated grade if the sample unit has "T" of less defects.

7. *Production which fails the designated grade.* When a portion of production fails the designated grade, it is necessary to assign a lower grade. A single sampling plan is used to determine the lower grade. The same sample unit results are used without recalculations. The sample size is the sample unit size for the CuSum sampling plan. The acceptance number is the sum, "T" plus "L," for the next lower grade. If the number of defects in the sample unit does not exceed "T" plus "L," the production is assigned that lower grade. Usually, when production fails the designated grade, it will pass the next lower grade.

8. *Two (2) consecutive sample unit failure rule.* Small sample sizes are used to make grading decisions for on-line inspection, due to time and costs of inspection. Thus, the CuSum sampling plan may allow some poorer quality to pass for the designated grade. The single sampling plan is even looser than the CuSum sampling plan. It permits the maximum number ("T" plus "L") of defects in each sample unit. This creates a situation where production is designated grade A, but quality is actually grade B or worse. The single sampling plan gives production even a greater chance of passing. In this situation a producer could take advantage of the CuSum sampling plan for the designated grade, and the single sampling plan for the lower grades.

   To improve the accuracy of the on-line sampling procedure, and to discourage possible intentional abuse, a two (2) consecutive failure rule has been added to the on-line plan. When two successive portions of production have failed the designated grade, the quality level has probably dropped below the designated grade. If production is at the AQL, the probability of two consecutive failures is less than 1.0 percent. This rule will seldom be used unless production quality has actually slipped below the designated grade.

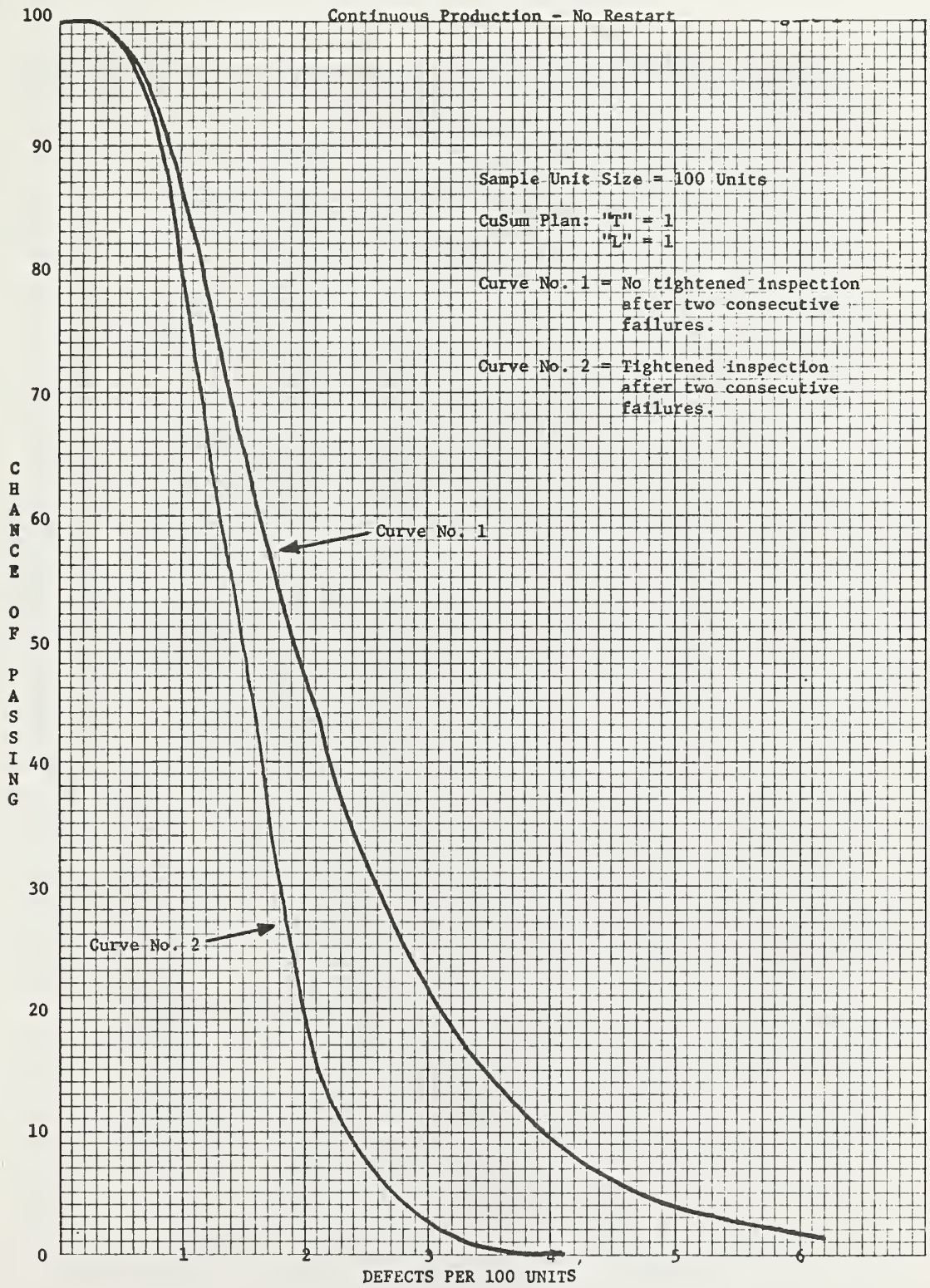
STATISTICAL EXPLANATION OF ON-LINE SAMPLING PROCEDURES (continuation)

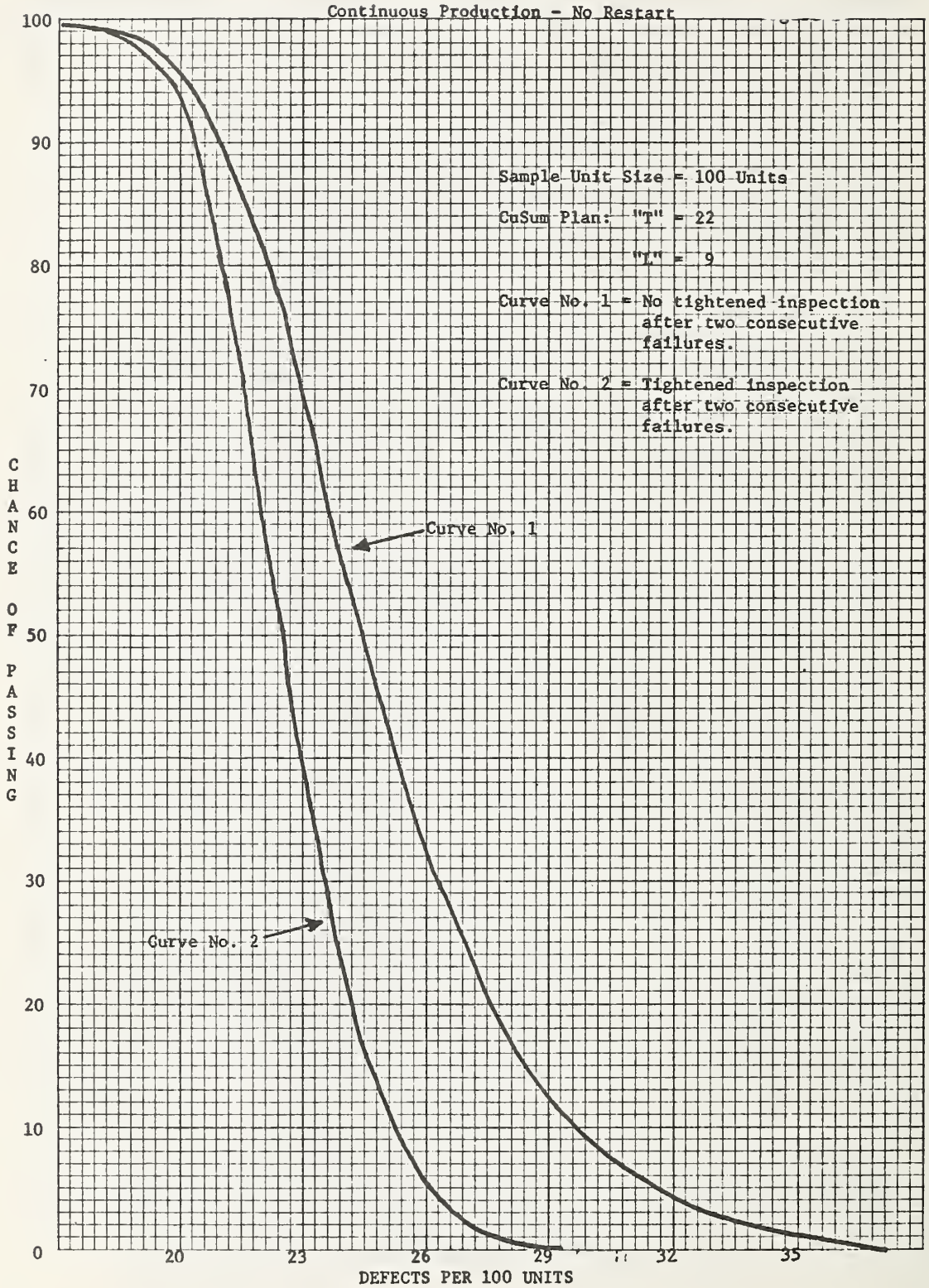
8. *(continuation)* Inspection for the designated grade may resume when three consecutive sample units meet the sample tolerance, "T," for each class of defects in the designated grade and the CuSum value is zero "0" in the lower grade. This requirement is similar to the CuSum sampling plan, where the sample unit following a failure must meet the tolerance, for the production to pass the designated grade. In most situations, the production represented by the three consecutive sample units within the tolerance may be recovered for the designated grade *(see the appendix of this manual)*.

   The effect of the two consecutive failure rule on the CuSum sampling plan being used for the designated grade, is illustrated in the OC curves shown in Figures 1 and 2 *(see the next two pages of this manual)*. The OC curves show a comparison of the CuSum sampling plan with the two consecutive failure rule for a small AQL (1 defect per 100 units) and a larger AQL (20 defects per 100 units). This rule tightens the CuSum sampling plan on quality levels which exceed the AQL. The chance of passing at the AQL has only a small decrease. The two consecutive failure rule reduces the chance of accepting poor quality for the designated grade with a minimal chance at the AQL.

9. *Assigning a grade to production.* In a true on-line inspection situation, each portion of production which is represented by a sample unit, is separately identifiable. The on-line sampling procedures assign a grade to each portion of production. However, in our on-line inspection, each portion of production will often not be separately identified due to the costs and time loss in changing codes. All production with the same code must be assigned the same grade, since the portions that are graded differently can not be identified. All production that is similarly coded must receive the lowest grade assigned to any portion of production using that code. This is to protect the *buyer or consumer*.

   The producer would obtain the greatest benefit from the CuSum sampling plan by separately identifying each portion of production. If the code is not changed for each portion of production, the risks of failing the designated grade are increased. Each producer must weigh these increased risks against the costs to determine how frequently codes should be changed.


Continuous Production - No Restart
Sample Unit Size = 100 Units
CuSum Plan: "T" = 1
"L" = 1
Curve No. 1 = No tightened inspection after two consecutive failures.
Curve No. 2 = Tightened inspection after two consecutive failures.
Curve No. 1
Curve No. 2
CHANCE OF PASSING
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
DEFECTS PER 100 UNITS


Continuous Production - No Restart
Sample Unit Size = 100 Units
CuSum Plan: "I" = 22
"L" = 9
Curve No. 1 = No tightened inspection after two consecutive failures.
Curve No. 2 = Tightened inspection after two consecutive failures.
Curve No. 1
Curve No. 2
CHANCE OF PASSING
100
90
80
70
60
50
40
30
20
10
0
20
23
26
29
32
35
DEFECTS PER 100 UNITS

HOW TO CHOOSE THE APPROPRIATE CUSUM SAMPLING PLANS.

1. Use the U.S. standards or other applicable specifications for the product.

   Example: "U.S. Standards for Grades of Canned Clingstone Peaches"

   or

   "_____ Foods, Inc., Product Specifications for Canned Clingstone Peach Halves, effective_____."

2. Use the applicable AQLs for the designated grade.

   Example:

	U.S. GRADE B			
	Total	*Major*	*Severe*	*Critical*
AQL 2/	*20.0*	*12.5*	*5.0*	*1.0*

or

"_____ Foods, First Label Canned Clingstone Peach Halves shall conform to the effective U.S. Standards for Grades of Canned Clingstone Peaches with the following modification:"

	Total	*Major*	*Severe*	*Critical*
AQL 2/	*15.0*	*10.0*	*5.0*	*1.0*

1/ AQLs expressed as defects per 100 units.

HOW TO CHOOSE THE APPROPRIATE CUSUM SAMPLING PLAN (continuation).

2. Use the applicable AQLs (continuation).

Example:

	Defect Action Level					
	5	*10*	*12*	*15*	*20*	*25*
	Positive Fields					
S	*0*	*1*	*0*	*1*	*0*	*1*
T	*1*	*2*	*3*	*3*	*5*	*6*
L	*1*	*3*	*2*	*3*	*2*	*3*
AQL 1/	*2.5*	*6.5*	*8.5*	*10.0*	*15.0*	*20.0*

3. Use the applicable standard sample unit size.

Example: "2852.2564 Recommended Sample Unit Sizes.

*(a) * * **

(1) Halves; Quarters -- 25 Units"

or

"_____Foods, Inc., Specification.

SAMPLE UNIT SIZE:

Draw 25 halves at 30 minute intervals."

1/ AQLs expressed as percent defective.

HOW TO CHOOSE THE APPROPRIATE CUSUM SAMPLING PLAN (continuation).

4. Select the CuSum values ("S," "T," "L") from the "Regulations" (File Code 109, §2852.38b) or other procedures that match the AQL and the standard sample unit size. *1/*

Example:

TABLE VII
CUSUM SAMPLING PLANS

STANDARD SAMPLE UNIT SIZE = 25

AQL	*S*	*T*	*L*	*Quality Levels* *Pa=50%*	*Pa=10%*
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS OR PERCENT DEFECTIVE					
* * *					
Critical					
1.0	*0*	*0.5*	*0.5*	*4.0*	*10.0*
* * *					
Severe					
5.0	*1.5*	*1.5*	*3*	*9.1*	*16.3*
* * *					
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS ONLY					
* * *					
Major					
12.5	*1*	*4*	*3*	*21.0*	*32.4*
* * *					
Total					
20.0	*1*	*6*	*4*	*29.7*	*42.7*
* * *					

1/ CuSum values will usually be preprinted on the defect tally sheet.

HOW TO CHOOSE THE APPROPRIATE CUSUM SAMPLING PLAN (continuation).

5. If the AQL specified in the U.S. standards or other specification is not available in the "Regulations," do the following:

   a. Use the next AQL in the "Regulations" that is on the restrictive side of the designated grade (or designated AQL).

Example:

	U.S. GRADE B			
	Total	*Major*	*Severe*	*Critical*
AQL 1/	*26.0*	*11.0*	*3.0*	*0.75*

adjust to the following AQLs

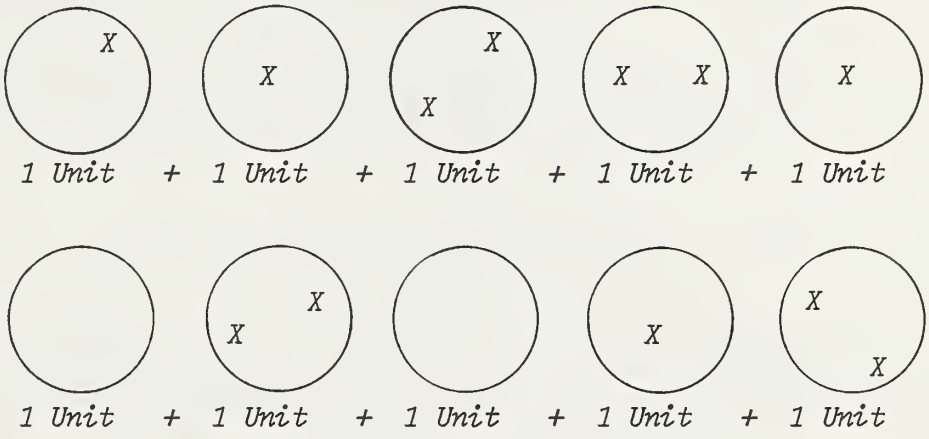
	U.S. GRADE B			
	Total	*Major*	*Severe*	*Critical*
AQL 1/	*25.0*	*10.0*	*2.5*	*0.65*

   b. Accept or reject based on the adjusted AQLs.

1/ AQLs expressed as defects per 100 units.

HOW TO DETERMINE THE DIFFERENCE BETWEEN DEFECTS PER HUNDRED UNITS AND PERCENT DEFECTIVE.

Example: (Each "X" represents one defect)



10 units have 12 defects (or 12 defects per 10 units)

or $\frac{12}{10} \times 10 = \frac{120}{100}$ *120 defects per 100 units*

However, only 8 units are defective (80% defective)

Defects per 100 units may exceed the number of units that you're grading

but

Percent defective cannot exceed the number of units of product

HOW TO USE THE PROBABILITY OF ACCEPTANCE ("Pa").

The CuSum sampling plans in the "Regulations" give the probability of acceptance (Pa) at the 50/50 level and at the 10/90 level in defects per 100 units (or percent defective) for each indexed AQL. The probability of acceptance will change if the standard sample unit size is increased or decreased. The larger the sample unit size, the better the protection against poorer quality production. However, the larger sample unit sizes increase the time and costs of inspection. The U.S. standards will recommend which sample unit size to use.

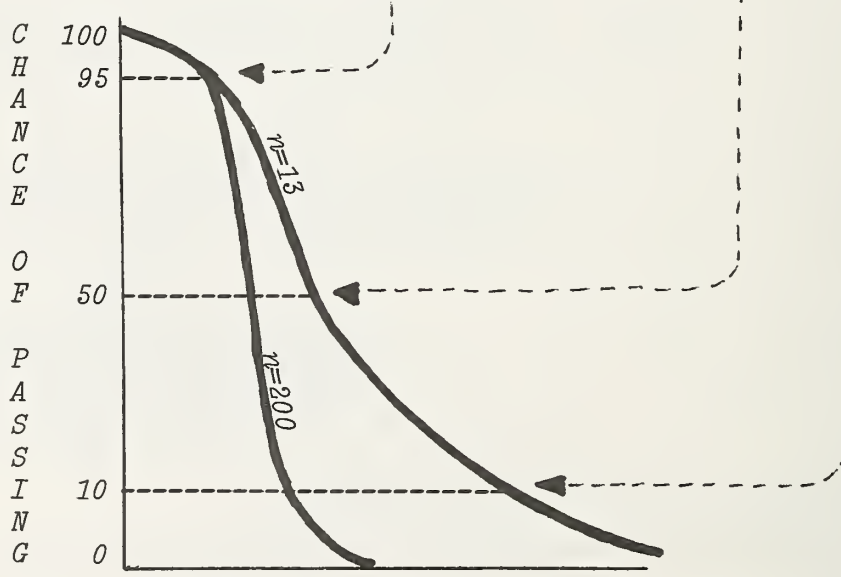
Example: (Relationship of Pa to the OC Curve)

TABLE X
CUSUM SAMPLING PLANS
STANDARD SAMPLE UNIT SIZE = 200

AQL	S	T	L	Pa=50%	Pa=10%
10.0	3	22	9	12.2	14.8

TABLE VI
CUSUM SAMPLING PLANS
STANDARD SAMPLE UNIT SIZE = 13

AQL	S	T	L	Pa=50%	Pa=10%
10.0	1	1.8	2.6	18.8	32.0



HOW TO COMPUTE CUSUM VALUES.

At the beginning of the basic inspection period, set the CuSum value equal to the Starting value ("S") for each class of defects ("critical," "severe," "major," and "total all classes") of the designated grade. Compute the CuSum value for each sample unit as follows:

1. Add the number of defects (or defectives) in the sample unit that you're working with to the CuSum value (carry over) from the previous sample unit.

2. Subtract the Sample Unit Tolerance ("T").

Reset the CuSum value in the following situations:

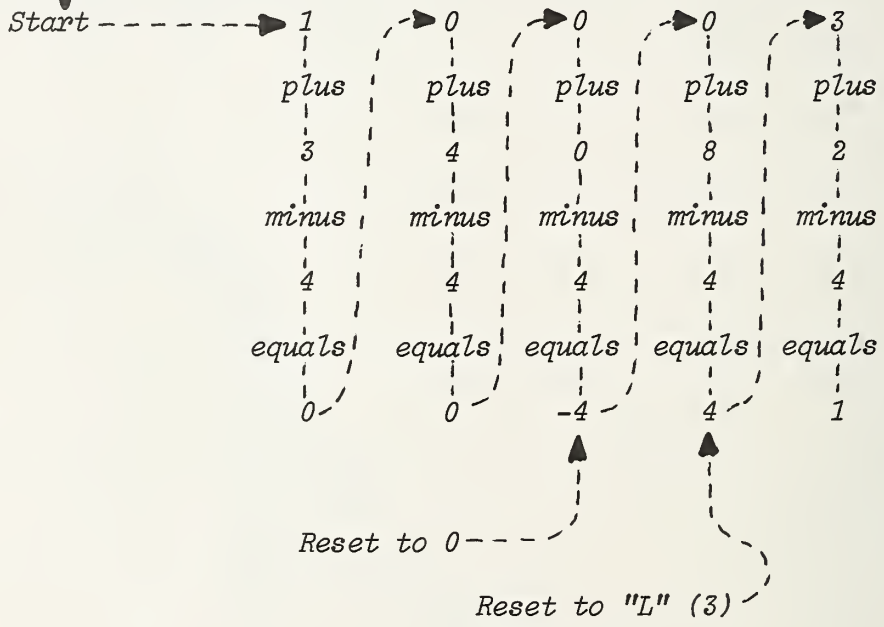
1. When the CuSum value is less than zero (0), reset the CuSum value to zero (0).

2. When the CuSum value exceeds the Acceptance Limit ("L"), reset the CuSum value to ("L").

HOW TO COMPUTE CUSUM VALUES (continuation).

Example 1: (showing only major defects)

			S	T	L					
MAJOR	Color					1	2		4	2
	Blemished					1	2		2	
	Edible Fiber					1			2	
	Total Major					3	4	0	8	2
	CUSUM	A	1	4	3	0	0	0	(3)	1

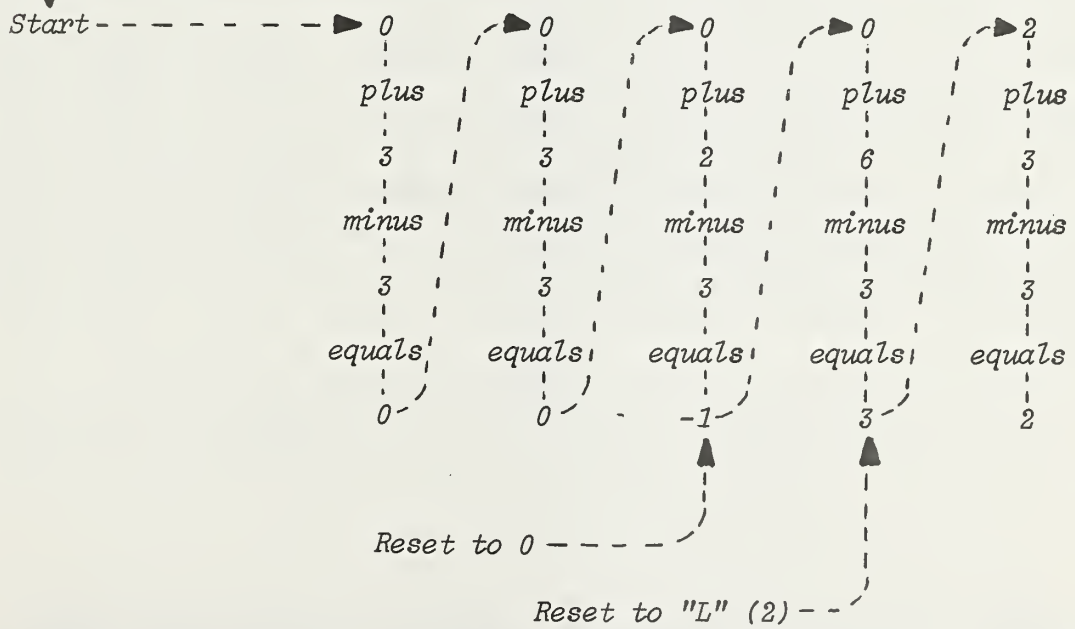


FORMULA: Carry Over (Old CuSum) + Defects - Tolerance = New CuSum

HOW TO COMPUTE CUSUM VALUES (continuation).

Example 2: (showing only mold count record)

DEFECT ACTION LEVEL: 12%	*PRODUCT: Canned Tomatoes*				
CODE:					
TIME:					
DATE:	– – – – –	– – – – –	– – – – –	+ – – + –	– – – – –
SAMPLE	– – – + –	– + – – –	– – – – –	– – + – –	+ – – – –
RATE:	– – – – –	– – – + –	– – + – –	– + – – –	– – – + –
	– + – – –	– – – – –	– + – – –	– – – + –	– – – – –
	– – – + –	– – + – –	– – – – –	+ – – – –	– + – – –
TOTAL POS. FIELDS	3	3	2	6	3
S 0 | *T* 3 | *L* 2	0	0	0	(2)	2
MEETS/FAILS	*Meets*	*Meets*	*Meets*	*Fails*	*Meets*
COUNTER:					

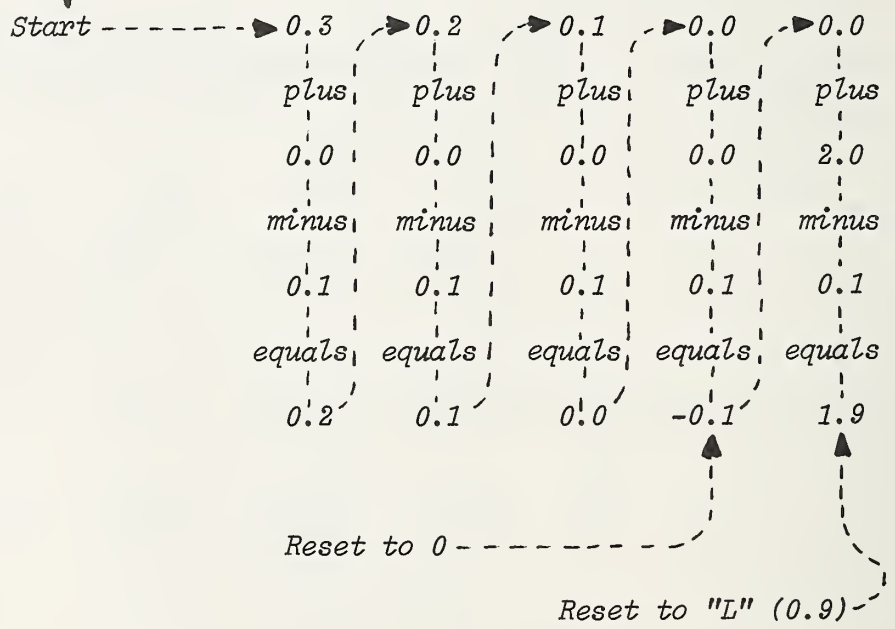


FORMULA: Carry Over (Old CuSum) + Positive Fields - Tolerance = New CuSum

HOW TO COMPUTE CUSUM VALUES (continuation).

Example 3: (decimal fractions showing only severe defects)

			S	T	L					
SEVERE	EVM									1
	Tough Fiber									1
	Total Severe					0	0	0	0	2
	CUSUM	A	0.3	0.1	0.9	0.2	0.1	0	0	0.9

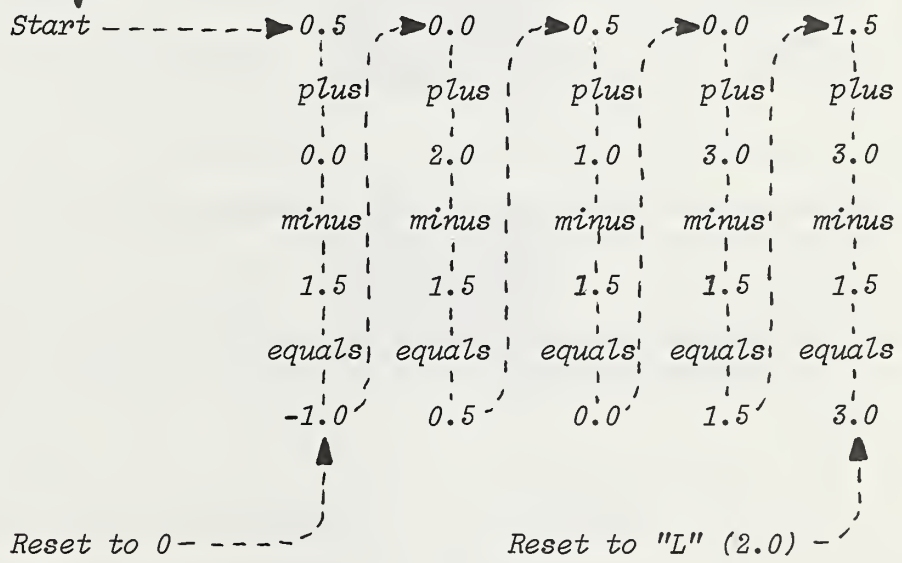


FORMULA: Carry Over (Old CuSum) + Defects - Tolerance = New CuSum

HOW TO COMPUTE CUSUM VALUES (continuation).

Example 4: (decimal compound fractions showing only major defects)

			S	T	L					
MAJOR	Blemished						1	1	1	1
	Off-suture								1	1
	Gouge						1		1	1
	Total Major					0	2	1	3	3
	CUSUM	A	0.5	1.5	2.0	0	0.5	0	1.5	(2.0)



FORMULA: Carry Over (Old CuSum) + Defects - Tolerance = New CuSum

HOW TO COMPUTE CUSUM VALUES (continuation).

Example 5: (showing all classes of defects)

			S	T	L						
CRITICAL	Pit Material							1	1		2
	Total Critical					0	0	1	1	0	2
	CUSUM	A	0.5	0.5	1.5	0	0	0.5	1	0.5	1.5
SEVERE	Color						1	1			
	Blemished							1		1	
	Total Severe					0	1	2	0	1	0
	CUSUM	A	1	1	2	0	0	1	0	0	0
MAJOR	Character					2			2	1	4
	Gouge					1		2	1	1	4
	Total Major					3	0	2	3	2	8
	CUSUM	A	1	4	3	0	0	0	0	0	3
MINOR	Off-suture					3	1	2	6	1	
	Short Stem					2	3	4	4	4	
	Total Minor					5	4	6	10	5	0
TOTAL	Total All Classes					8	5	11	14	8	10
	CUSUM	A	1	9	4	0	0	2	4	3	4

Reset to "L"

FORMULA: Carry Over (Old CuSum) + Defects - Tolerance = New CuSum

HOW FREQUENTLY TO DRAW THE STANDARD SAMPLE UNIT SIZE FOR INSPECTION.

Use the time sampling plan outlined in File Code 120. The sample unit should be drawn so that only the inspector can predict the actual time of sampling. Do not fall into a predictable time-frame sampling.

Acceptable sampling frequencies are: high volume, medium volume, low volume, optional rate, pallet by pallet and tote by tote inspection. See also the appendix of this manual for "modification of sampling frequency" and "tote by tote inspection."

HOW TO EVALUATE A SAMPLE UNIT.

1. *Prerequisite quality factors.* Evaluate and record each prerequisite quality factor which is applicable for the product (overall appearance, flavor and odor, etc.). Prerequisites are recorded as either "A," "B," "C" or Substandard. 1/

2. *Classified defects.*

   a. Determine and record the number of defects of each kind and class in the appropriate boxes indicated for the defects;

   b. Count the total number of classified defects for each class (minor, major, severe, and critical);

   c. Record the number of defects in each class in the appropriate boxes opposite "Total Critical," "Total Severe," "Total Major," and "Total Minor";

   d. Add the total number of classified defects found in all classes in the sample unit and record this number opposite "Total All Classes."

3. *Other defects, if any.* Some U.S. standards may have defects that are not classified as minor, major, severe or critical. Count and record these defects as instructed by the grading manual for each product.

1/ *Consider prerequisites independently of the classified defects. Therefore, record the prerequisites as the actual grade that they are assigned and not the designated grade. This is important if tally sheets are later reevaluated to determine if production has met a special specification, such as a buyer's spec.*

HOW TO INSPECT PRODUCTION.

STEP 1 - MEETS DESIGNATED GRADE.

If the CuSum value is less than or equal to the Acceptance Limit ("L") for all classes of defects, the portion of production represented by that sample unit meets the requirements of the designated grade.

Example 1: (Designated grade A showing only critical defects)

			S	T	L					
CRITICAL	Pit Material						1			
	Total Critica					0	1	0	0	0
	CUSUM	A	0.2	0.2	0.8	0	0.8	0.6	0.4	0.2
		B	0.5	0.5	1.5					

Meets

Example 2: (Designated grade B showing only total defects)

			S	T	L					
TOTAL	Total All Classes					10	14	0	16	10
	CUSUM	A	1	8	3					
		B	2	12	5	0	2	0	4	2

Meets

HOW TO INSPECT PRODUCTION (continuation).

STEP 1 - MEETS DESIGNATED GRADE (continuation)

Example 3: (Designated grade B showing all classes of defects)

			S	T	L						
CRITICAL	EVM					1			3		1
	Total Critical					1	0	0	3	0	1
	CUSUM	A	0	1	1						
		B	1	2	2	0	0	0	1	0	0
		C	1	3	3						
SEVERE	Tough Fiber						1	2			1
	Blemished						1	1	1	1	
	Total Severe					0	2	3	1	1	1
	CUSUM	A	0.5	1.5	2						
		B	1	3	3	0	0	0	0	0	0
		C	1	5	3						
MAJOR	Edible Fiber					1	2	2		2	1
	Blemished						2	2	1	2	1
	Total Major					1	4	4	1	4	2
	CUSUM	A	1	3	3						
		B	1	5	3	0	0	0	0	0	0
		C	1	6	4						
MINOR	Damaged					2	4	4	3	1	1
	Blemished					2	4	2	2	1	1
	Total Minor					4	8	6	5	2	2
TOTAL	Total All Classe					6	14	13	10	7	6
	CUSUM	A	1	6	4						
		B	2	12	5	0	2	3	1	0	0
		C	2	17	7						
						←		Meets			→

HOW TO INSPECT PRODUCTION (continuation).

STEP 2 - FAILS DESIGNATED GRADE.

If the CuSum value exceeds the Acceptance Limit ("L") for one of more classes of defects, the portion of production represented by that sample unit fails requirements of the designated grade.

1. Determine if the sample unit *meets* or *fails* lower grades:

   a. *Do not* recalculate CuSum; and

   b. *Use* the sum of *T+L*, applicable to the lower grade, as the acceptance number for the failed sample unit (maximum number of defects permitted).

Example 1: (Designated grade A showing only major defects)

			S	T	L	Fails	◄—— Meets ——►			Fails
MAJOR	Color					5	2	1	1	12
	Gouge					3	1	1		
	Total Major					8	3	2	1	12
	CUSUM	A	1	3	3	(3)	3	2	0	(3)
		B	1	6	4	B				
		C	1	9	4					C

Meets grade B (T+L=10) - - - - -

Meets grade C (T+L=13) - - - - -

HOW TO INSPECT PRODUCTION (continuation).

STEP 2 - FAILS DESIGNATED GRADE (continuation).

Example 2: (Designated grade A showing only severe defects)

			S	T	L	← Meets →				Fails
MAJOR	EVM					1				3
	Uncolored							1		2
	Total Severe					1	0	1	0	5
	CUSUM	A	0	0.5	0.5	0.5	0	0.5	0	(0.5)
		B	0.4	0.8	1.6					→
		C	1.5	1.5	3					→

SSTD

Fails grade B (T+L=2.4)

Fails grade C (T+L=4.5)

HOW TO INSPECT PRODUCTION (continuation).

STEP 2 - FAILS DESIGNATED GRADE (continuation).

Example 3: (Designated grade B showing all classes of defects)

			S	T	L						
CRITICAL	EVM					2	2	1	1	5	1
	Total Critical					2	2	1	1	5	1
	CUSUM	A	0	1	1						
		B	1	2	2	1	1	0	0	(2)	1
		C	1	3	3					C	
SEVERE	Tough Fiber					1	4	1	1	1	1
	Blemished						3	1	1	1	
	Total Severe					1	7	2	2	2	1
	CUSUM	A	0.5	1.5	2.0						
		B	1	3	3	0	(3)	2	1	0	0
		C	1	5	3		C				
MAJOR	Edible Fiber					2	3	2	3	3	2
	Blemished					2	2	2	2	2	2
	Total Major					4	5	4	5	5	4
	CUSUM	A	1	3	3						
		B	1	5	3	0	0	0	0	0	0
		C	1	6	4						
MINOR	Damaged					1	1		4	4	2
	Blemished					1	1	1		4	2
	Total Minor					2	2	1	4	8	4
TOTAL	Total All Classe					9	16	8	12	20	10
	CUSUM	A	1	6	4						
		B	2	12	5	0	4	0	0	(5)	3
		C	2	17	7					C	

	Meets	Fails	←Meets→	Fails	Meets	

HOW TO INSPECT PRODUCTION (continuation).

STEP 3 - TWO (2) SAMPLE UNITS IN A ROW FAIL THE DESIGNATED GRADE.

If the CuSum value for 2 sample units in a row exceeds a specified Acceptance Limit ("L") of the designated grade for any class of defects:

1. Inspect subsequent production at the lowest grade of the two consecutive failing sample units;

   a. Start CuSum equal to "S" of the lower grade for all classes of defects;

   b. Calculate CuSum at the lower grade for all classes of defects;

2. Resume inspection for the designated grade only when three (3) consecutive sample units; 1/

   a. Are zero (0) CuSum value in the lower grade;

   b. And the number of defects in each sample unit is less than or equal to the Tolerance ("T") of the designated grade for all classes of defects;

3. Restart CuSum equal to "S" of the designated grade for any production which follows the three consecutive sample units that meet.

EXCEPTION: Step 3 does not apply to prerequisites.

Example 1: (does not count as 2 in a row)

Sample Unit Number	1	2	3	4	5	6
Prerequisites:						
Overall appearance	A	(B)	A	A	(B)	A
Flavor and odor	A	A	A	A	A	(B)
Classified defects: (*After computing the CuSum value and assigning a grade*)	A	A	(B)	A	A	A
Sample Unit Grade	A	(B)	(B)	A	(B)	(B)

1/ *See also page 38 of this manual (recovery of step 3 failure).*

HOW TO INSPECT PRODUCTION (continuation).

STEP 3 - TWO (2) SAMPLE UNITS IN A ROW FAIL THE DESIGNATED GRADE (continuation).

Example 2: (Designated grade A showing only severe defects)

			S	T	L						
SEVERE	Total Severe					2	2	0	0	0	0
	CUSUM	A	0	0.5	0.5	(0.5)	(0.5)				0
		B	0.4	0.8	1.6	B	B	0	0	0	
		C	1.5	1.5	3.0						

2 in a row fail grade A

Start CuSum at "S" of grade B

3 in a row meet (0) CuSum at the lower grade and defects do not exceed "T" of the designated grade

Start CuSum at "S" of the designated grade and resume inspection at grade A for all following production

HOW TO INSPECT PRODUCTION (continuation).

STEP 3 - TWO (2) SAMPLE UNITS IN A ROW FAIL THE DESIGNATED GRADE (continuation).

Example 3: (Designated grade B showing total all classes of defects)

			S	T	L									
TOTAL	Total All Classes					17	24	20	18	16	17	15	16	17
	CUSUM	A	2	12	5									
		B	2	17	7	2	7	7					1	1
		C	3	22	9		C	C	0	0	0	0		

Fails B

2 in a row fail grade B

Start CuSum at "S" of grade C

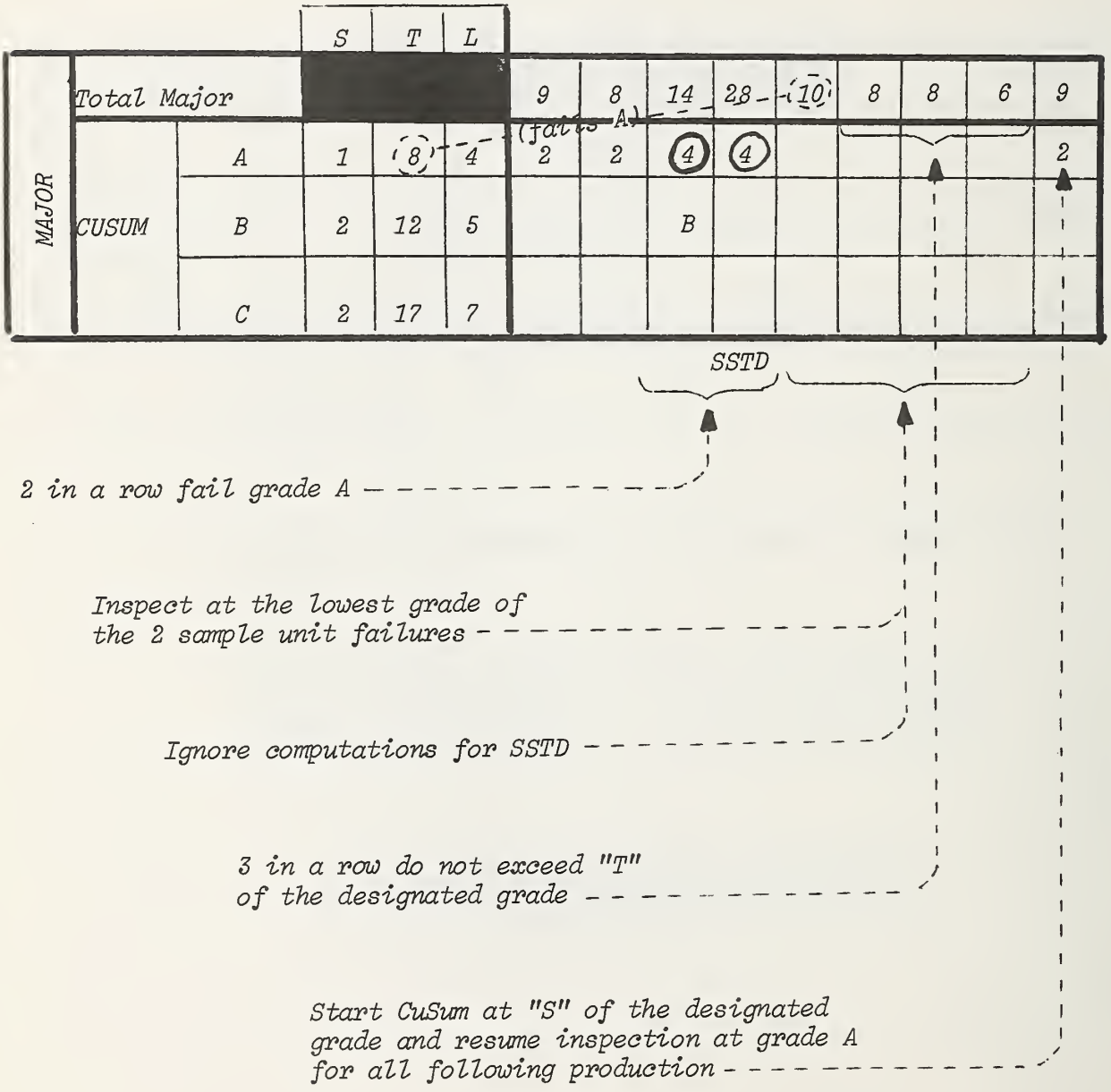
3 in a row meet (0) CuSum at the lower grade and defects do not exceed "T" of the designated grade

Start CuSum at "S" of the designated grade and resume inspection at grade B for all following production

HOW TO INSPECT PRODUCTION (continuation).

STEP 3 - TWO (2) SAMPLE UNITS IN A ROW FAIL THE DESIGNATED GRADE (continuation).

Example 4: (Designated grade A showing only major defects)



HOW TO INSPECT PRODUCTION (continuation).

STEP 3 - TWO (2) SAMPLE UNITS IN A ROW FAIL THE DESIGNATED GRADE (continuation).

Example 5: (Designated grade A showing all classes of defects)

			S	T	L									
Production Code														
PRE.	Overall Color					A	A	A	A	A	A	A	A	A
	Flavor and Odor					A	A	A	A	A	A	A	A	A
	Peel (Area)					A	A	A	A	A	A	A	A	A
CRITICAL	Pit Material								1					
	Total Critical					0	0	0	1	0	0	0	0	0
	CUSUM	A	0.3	0.1	0.9	0.2	0.1	0					0.2	0.1
		B	0	0.5	0.5				0.5	0	0	0		
		C	0	1	1									
SEVERE	EVM					1	1							
	Off-suture												1	
	Total Severe					1	1	0	0	0	0	0	1	0
	CUSUM	A	0	0.5	0.5	0.5	(0.5)	0					0.5	0
		B	0	1	1		B		0	0	0	0		
		C	0.5	1.5	2.0									
MAJOR	Color					1	1	2			1			
	Gouge					1		2					1	
	Total Major					2	1	4	0	0	1	0	1	0
	CUSUM	A	0	1	1	1	1	(1)					0	0
		B	1.5	1.5	3.0			B	0	0	0	0		
		C	0	3	2									
MINOR	Short Stems								1					
	Blemished					1			1	1	1			1
	Total Minor					1	0	0	2	1	1	0	0	1
TOTAL	Total All Classes					4	2	4	3	1	2	0	2	1
	CUSUM	A	1	2	3	3	3	(3)					1	0
		B	1	3	3			B	1	0	0	0		
		C	1	5	3									
Sample Unit Grade							◄—Fails—►							
Production Grade														

HOW TO INSPECT PRODUCTION (continuation).

STEP 4 - REDESIGNATION OF PRODUCTION GRADE.

If the grade of production is redesignated:

1. To a *higher* grade;

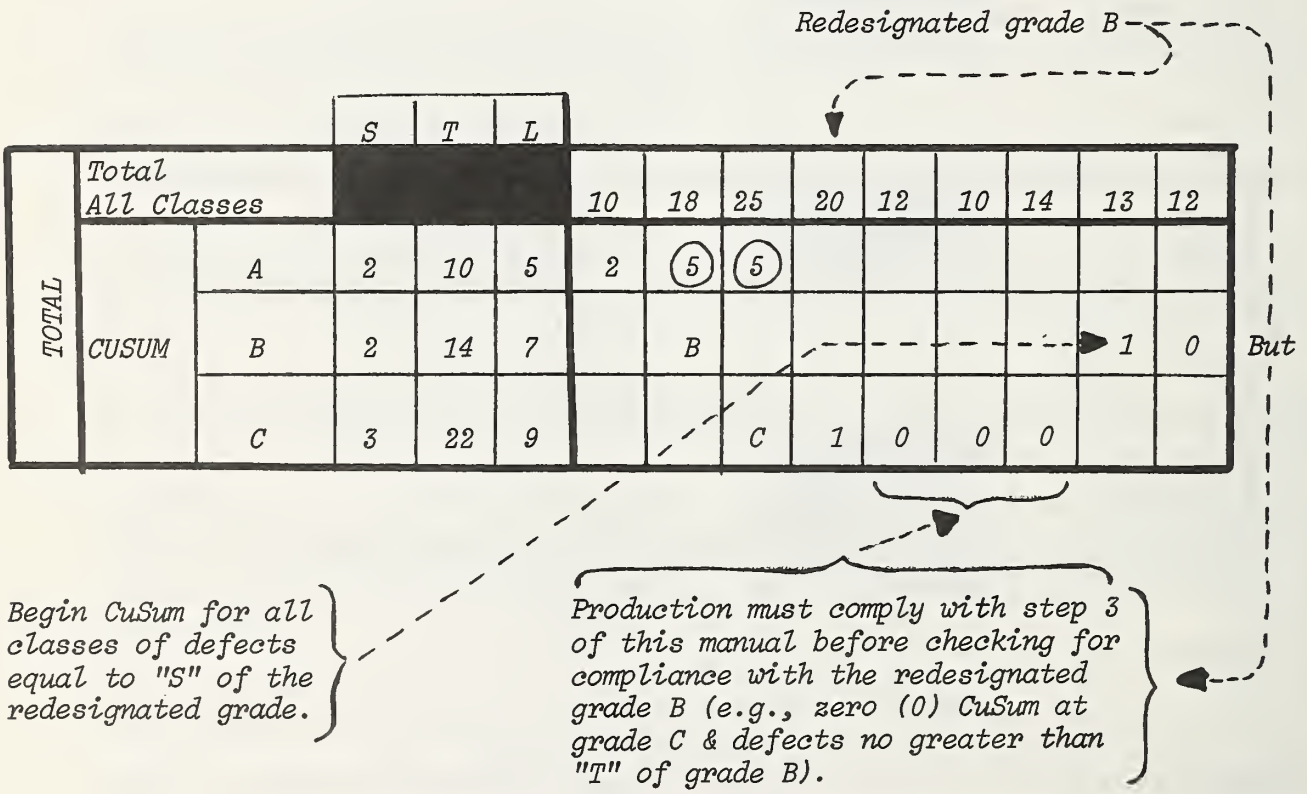
    a. Begin CuSum for all classes of defects at the "S" value of the higher grade;

2. To a *lower* grade;

    a. Begin CuSum for all classes of defects at the "S" value of the lower grade.

Redesignation of the production grade does not remove the restrictions placed on production by step 3. (See also page 40 of this manual).

Example 1: (Redesignated grade B showing total all classes of defects)



HOW TO INSPECT PRODUCTION (continuation).

STEP 4 - REDESIGNATION OF PRODUCTION GRADE (continuation).

Example 2: (Redesignated grade A showing only major defects)

Redesignated grade A

			S	T	L									
MAJOR	Total Major					20	10	22	20	20	0	25	20	22
	CUSUM	A	3	22	9				1	0	0	3	1	1
		B	4	43	12	0	0	0						
		C	6	84	18									

Begin CuSum for all classes of defects equal to "S" of the redesignated grade.

HOW TO INSPECT PRODUCTION (continuation).

STEP 4 - REDESIGNATION OF PRODUCTION GRADE (continuation).

Example 3: (Redesignation of grade showing all classes of defects)

Redesignated grade A ---------- *Redesignated grade C*

			S	T	L									
Production Code														
PRE.	*Similar Varietal Characteristics*					A	A	A	A	A	A	A	A	A
	Overall Color					A	A	A	A	A	A	A	A	A
	Flavor and Odor					A	A	A	A	A	A	A	A	A
CRITICAL	*EVM*						1		1			2	4	5
	Total Critical					0	1	0	1	0	0	2	4	5
	CUSUM	*A*	1	1	2			0	0	0	0	1		
		B	1.0	2.5	3.0	0	0							
		C	1	4	3								1	2
SEVERE	*Tough Fiber*					1		1	1			1	1	1
	EVM						1	1	1			1	1	1
	Total Severe					1	1	2	2	0	0	2	2	2
	CUSUM	*A*	1.0	2.5	3.0			0.5	0	0	0	0		
		B	1	4	3	0	0							
		C	1	6	4								0	0
MAJOR	*Edible Fiber*					1	1	1	1	1		1	1	1
	Blemished					1	1	1	1	1		1	1	1
	Total Major					2	2	2	2	2	0	2	2	2
	CUSUM	*A*	1	6	4			0	0	0	0	0		
		B	1	10	4	0	0							
		C	2	12	5								0	0
MINOR	*Blemished*					1	2	1	2	1		1	2	10
	Damaged					1	1	1	2	1		1	2	10
	Total Minor					2	3	2	4	2	0	2	4	20
TOTAL	*Total All Classe*					5	7	6	9	4	0	8	12	29
	CUSUM	*A*	2	15	6			0	0	0	0	0		
		B	3	22	9	0	0							
		C	4	27	10								0	2
Sample Unit Grade														
Production Grade														

HOW TO INSPECT PRODUCTION (continuation).

STEP 5 - ASSIGNING A GRADE TO PRODUCTION.

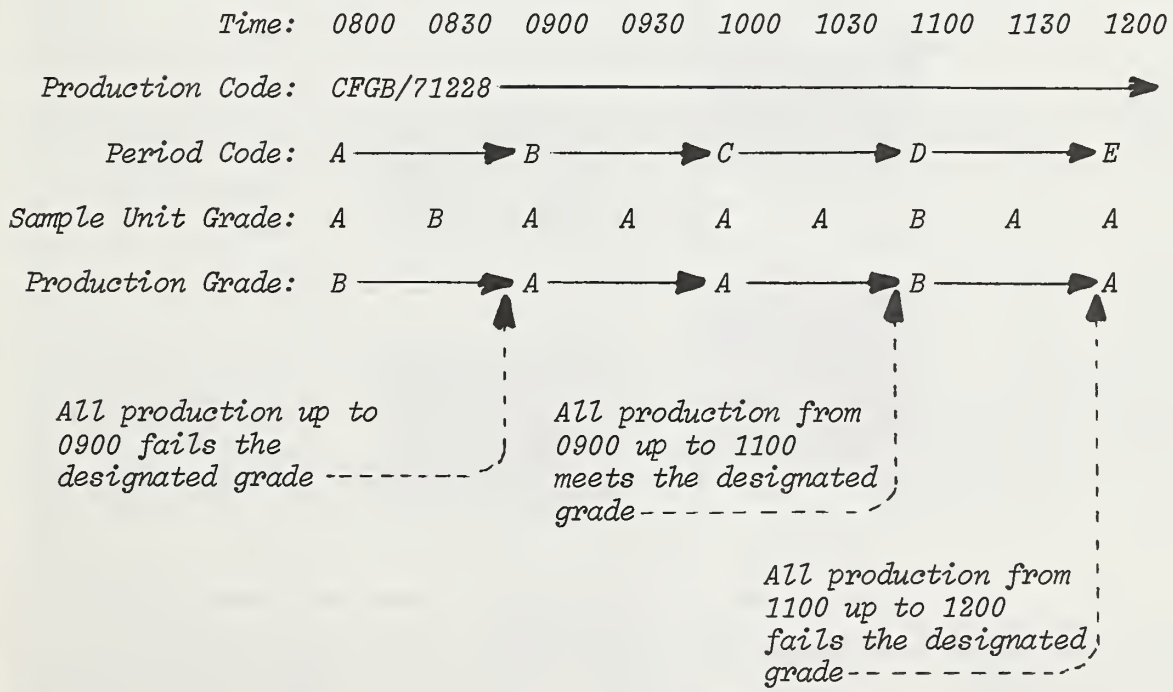
When similarly coded production is represented by more than one sample unit, the grade for that production is determined as follows:

1. If each portion of production (period code, subcode, tote bin, pallet, label, drum, etc.) is acceptable for the designated grade, all of the production is accepted for the designated grade.

2. If any portion of production is not acceptable for the designated grade, all of that portion of production fails the designated grade.

3. A portion of production *may* be accepted by one sample unit grade.

Example 1: (Designated grade A showing only code segregation policy)



HOW TO INSPECT PRODUCTION (continuation).

STEP 5 - ASSIGNING A GRADE TO PRODUCTION (continuation).

Example 2: (Designated grade A showing all classes of defects)

			S	T	L									
Production Code						A →			B →			C →		
PRE.	Overall Color					A	A	A	A	A	(B)	A	A	A
	Flavor and Odor					A	A	A	A	A	A	A	A	A
	Peel (Area)					A	A	A	A	A	A	A	A	A
CRITICAL	Pit Material										1			
	Total Critical					0	0	0	0	0	1	0	0	0
	CUSUM	A	0.3	0.1	0.9	0.2	0.1	0	0	0	0.9	0.8	0.7	0.6
		B	0	0.5	0.5									
		C	0	1	1									
SEVERE	EVM							1						
	Off-suture									1				
	Total Severe					0	0	1	0	1	0	0	0	0
	CUSUM	A	0	0.5	0.5	0	0	0.5	0	0.5	0	0	0	0
		B	0	1	1									
		C	0.5	1.5	2									
MAJOR	Color							1						
	Gouge						1	1				1		
	Total Major					0	1	2	0	0	0	1	0	0
	CUSUM	A	0	1	1	0	0	1	0	0	0	0	0	0
		B	1.5	1.5	3									
		C	0	3	2									
MINOR	Short Stems					1			1					1
	Blemished					1	1	1	2	1	1	0	1	1
	Total Minor					2	1	1	3	1	1	0	1	2
TOTAL	Total All Classe					2	2	4	3	2	2	1	1	2
	CUSUM	A	1	2	3	1	1	3	(3)	3	3	2	1	1
		B	1	3	3				B					
		C	1	5	3									
Sample Unit Grade						A	A	A	B	A	B	A	A	A
Production Grade						A →			B →			A →		

HOW TO INSPECT PRODUCTION (continuation).

STEP 5 - ASSIGNING A GRADE TO PRODUCTION (continuation).

Example 3: (Designated grade B showing all classes of defects)

Redesignated grade A ---------- *Redesignated grade C*

			S	T	L	X1	X2	X3	X4	X5	X6	X7	X8	X9
Production Code						X1	X2	X3	X4	X5	X6	X7	X8	X9
PRE.	*Similar Varietal Characteristics*					A	A	A	A	A	A	A	A	A
	Overall Color					A	A	A	A	A	(B)	A	A	A
	Flavor and Odor					A	A	A	A	A	A	A	A	A
CRITICAL	*EVM*					1		1		1		1		6
	Total Critical					1	0	1	0	1	0	1	0	6
	CUSUM	*A*	1	1	2			1	0	0	0	0	0	
		B	1.0	2.5	3	0	0							
		C	1	4	3									3
SEVERE	*Tough Fiber*					1						1	1	2
	EVM					1		1	1			1		5
	Total Severe					2	0	1	1	0	0	2	1	7
	CUSUM	*A*	1.0	2.5	3			0	0	0	0	0	0	
		B	1	4	3	0	0							
		C	1	6	4									2
MAJOR	*Edible Fiber*					1		1	1			1	2	
	Blemished					1		1	1			4	2	2
	Total Major					2	0	2	2	0	0	5	4	2
	CUSUM	*A*	1	6	4			0	0	0	0	0	0	
		B	1	10	4	0	0							
		C	2	12	5									0
MINOR	*Blemished*					3		1	2	2	2	1	1	1
	Damaged					2		1	2	2	2	1	1	1
	Total Minor					5	0	2	4	4	4	2	2	2
TOTAL	*Total All Classes*					10	0	6	7	5	4	10	7	17
	CUSUM	*A*	2	15	6			0	0	0	0	0	0	
		B	3	22	9	0	0							
		C	4	27	10									0
Sample Unit Grade						B	B	A	A	A	B	A	A	C
Production Grade						B →		A →			B	A →		C

APPENDIX.

1. *Recovery of production which follows a step 3 failure.*

When production fails the designated grade for 2 sample units in a row, inspection cannot be resumed for the designated grade until 3 consecutive sample units are zero (0) CuSum value at the lower grade and defects do not exceed "T" of the designated grade (see step 3 of this manual, page 27).

Production represented by the 3 consecutive sample units that meet may be recovered and assigned the designated grade, provided, that (1) the code (period code, subcode, tote, pallet, label, drum, etc.) is changed often enough to separate passing production from failing production; (2) the production in question is capable of being recovered and is not buried in the warehouse or freezer storage (e.g., frozen peas stored in silos probably cannot be recovered); (3) the tally sheet is recorded in a manner which will verify that the production may be recovered; and (4) the production meets step 3 of this manual, page 27.

Example 1: (Designated grade A showing only total defects)

			S	T	L									
Production Code						*A*	*B* →			*C* →			*D* →	
TOTAL	*Total All Classes*					*12*	*16*	*14*	*14*	*12*	*10*	*10*	*11*	*12*
	CUSUM	*A*	*2*	*12*	*5*	*2*	(5)	(5)					*1*	*1*
		B	*2*	*17*	*7*		*B*	*B*	*0*	*0*	*0*	*0*		
		C	*3*	*22*	*9*									
Sample Unit Grade						*A*	*B*	*B*	← *Unconfirmed* →				*A*	*A*
Production Grade						*A*	*B* →			*A* →				

2 in a row fail

3 in a row meet and may be recovered for the designated grade A

APPENDIX.

1. *Recovery of production which follows a step 3 failure (continuation).*

Example 2: (Designated grade B showing only major defects)

Production Code					X1	X2	X3	X4	X5	X6	X7	X8	X9
		S	T	L									
MAJOR	Total Major				1	4	3	2	2	1	1	1	1
	CUSUM A	1.0	0.5	2									
	CUSUM B	1.5	1.5	3	1	(3)	(3)						1
	CUSUM C	1	3	3		C	C	0	0	0	0	0	
Sample Unit Grade					B	C	C	← Unconfirmed →					B
Production Grade					B	C →				B →			

2 in a row fail

Recovered

Example 3: (Designated grade A showing only total defects)

Redesignated grade B — Production stopped

Production Code					M1	M2	M3		M4	M5	M6	M7	
		S	T	L									
TOTAL	Total All Classes				8	10	18		14	13	10	9	
	CUSUM A	1	6	4	3	(4)	(4)						
	CUSUM B	2	12	5		B							
	CUSUM C	3	18	9			C		0	0	0	0	
Sample Unit Grade					A	B	C		← Unconfirmed →				
Production Grade					A	B	C →						

Line shut down 15 minutes & cleaned

Not recovered

APPENDIX.

1. *Recovery of production which follows a step 3 failure (continuation).*

Example 4: (Redesignated grade B following 2 failures in a row).

Redesignated grade B

			S	T	L	C1	C2	C3	C4	C5	C6	C7	C8	C9
Production Code														
TOTAL	*Total All Classes*					10	18	25	20	12	10	14	13	12
	CUSUM	*A*	2	10	5	2	(5)	(5)						
		B	2	14	7		B						1	0
		C	3	22	9			C	1	0	0	0		
Sample Unit Grade						A	B	C →		Unconfirmed			B →	
Production Grade						A	B	C →		B →				→

Recovered

Example 5: (Recovery of Substandard)

			S	T	L	GB1	GB2	GB3	GB4	GB5	GB6	GB7	GB8	GB9
Production Code														
MAJOR	*Total Major*					9	8	14	28	10	8	8	6	9
	CUSUM	*A*	1	8	4	2	2	(4)	(4)					2
		B	2	12	5			B						
		C	2	17	7									
Sample Unit Grade						A	A	B	SSTD →		Unconfirmed			A
Production Grade						A →		B	SSTD →		A →			→

Recovered

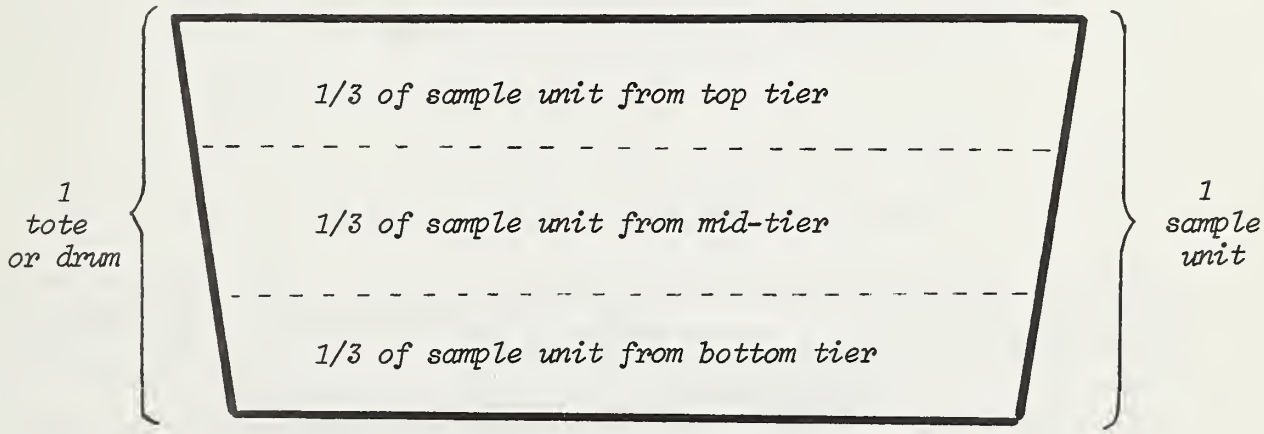
APPENDIX.

2. *Tote bin inspection (or other large units such as drums).*

For tote bin inspection or drum inspection, use the procedure as described in this manual (steps 1 through 5, and appendix). Totes and drums may be inspected on a unit-by-unit basis, if the applicant desires.

The standard sample unit size (200 green beans, 50 peas, 100 strawberries, etc.) may be drawn at random from the container or a composite may be drawn from each unit selected for sampling.

Example 1: (Composite standard sample unit size)



Tote-by-tote or drum-by-drum inspection does not change the requirements for production as outlined under step 3 of this manual. If two totes in a row fail the designated grade, 3 units in a row must comply with step 3 before production may be returned to the designated grade.

APPENDIX.

2. *Tote bin inspection (continuation).*

Example 2: (Designated grade A showing only total defects)

Tote Bin or Drum No.					BK1	BK2	BK3	BK4	BK5	BK6	BK7	BK8	BK9
		S	T	L									
TOTAL	Total All Classes				10	10	5	8	25	5	8	7	35
	CUSUM A	1	8	4	3	(4)	1	1	(4)	1	1	0	(4)
	CUSUM B	2	14	7		B							
	CUSUM C	3	22	9					C				
Sample Unit Grade					A	B	A →		C	A	→		SSTD
Production Grade					A	B	A →		C	A	→		SSTD

Example 3: (Designated grade A showing only total defects)

Tote Bin or Drum No.					C5	C10	C15	C20	C25	C30	C35	C40	C45
		S	T	L									
TOTAL	Total All Classes				6	12	12	6	5	0	6	4	5
	CUSUM A	1	6	4	1	(4)	(4)				1	0	0
	CUSUM B	2	12	5		B	B	0	0	0			
	CUSUM C	3	18	9									
Sample Unit Grade					A	B →		◄Unconfirmed►			A	→	
Production Grade					A	B →		A	→				

Sample unit drawn every 5th container. Thus, 10 thru 19 are grade B.

APPENDIX.

3. *Reinspection of failed production.*

Failed production or any portion of production may be accepted as a lot on its own or with other production of the same grade (quality level) and is considered the grade assigned at the time of production. Any request for reinspection of production failed under the CuSum plan must be accomplished as an *appeal lot inspection.* However, the product may be reexamined at any time to update certification or verify for condition.

4. *Modification of sampling frequency.*

The time sampling frequency may be adjusted, if it is necessary, following a production failure to meet the designated grade. This is important if production is being sampled at a low or medium frequency. Otherwise, a severe penalty would be imposed on the producer by just a small pocket of lower quality production. But, this flexibility of sampling frequency *shall not be abused.* (Only *you* can determine if the sampling frequency is being abused).

Example 1: (Designated grade A showing only total defects)

Time →					0800	0845	0930	1015	1030	1045	1100	1115	1130
Production Code					*FS1*	*FS2*	*FS3*	*FS4*	*FS5*	*FS6*	*FS7*	*FS8*	*FS9*
		S	*T*	*L*									
TOTAL	*Total All Classes*				3	3	3	6	6	3	2	3	2
TOTAL	*CUSUM* A	1	3	3	1	1	1	③	③				0
TOTAL	*CUSUM* B	1	5	3				B	B	0	0	0	
TOTAL	*CUSUM* C	1	6	4									
Sample Unit Grade					A →			B →		*Unconfirmed*			A
Production Grade					A →			B →		A →			

Medium frequency (FS1–FS4)

Changed to optional frequency (FS5–FS9)

APPENDIX.

5. *Mold counting example (See File Code 135-A-8).*

DEFECT ACTION LEVEL: 40% *PRODUCT:* Tomato Paste

	Drum #4	Drum #8
CODE:		
TIME:		
DATE:		
SAMPLE RATE:		
TOTAL POS. FIELDS	10	14
S 1 | T 10 | L 4	1+10-10=1	1+14-10=5 (4)
MEETS/FAILS	Meets	Fails
COUNTER:		

Howard Method

		ACC.	REJ.
Drum #5			
$\frac{15}{50} \times 100 = 30\%$		X	
Drum #6			
$\frac{15}{50} \times 100 = 30\%$		X	
Drum #7			
$\frac{25}{50} \times 100 = 50\%$			X

Optional method: Count back from the point where the Limit ("L") was exceeded to the last acceptable count. See page 3.4, File Code 135-A-8

APPENDIX.

5. Mold counting example using 135-A-8 (continuation).

DEFECT ACTION LEVEL: 40%	PRODUCT: Tomato Paste	
CODE:	Drum #8	Drum #11
TIME:		
DATE:		− − − + −
SAMPLE		− + − − +
RATE:		− − − + −
(See page 44)		− + − − +
		+ − + − −
TOTAL POS. FIELDS	14	8
S 1 | T 10 | L 4	14+4−10=5 (4)	4+8−10=2
MEETS/FAILS	Fails	Meets
COUNTER:		

Howard Method

		ACC.	REJ.
Drum #9	+ − − + − + − + − − + − + − + − + − − + + − + + − + + − − + − − + + − + − − + − + + + − + − + − + −		X
Drum #10	+ − − + − − + − − + − − + − − + − − − − − − − + − + − + − − + − − + − − − + − + − − + − − + − − − −	X	

$\frac{25}{50} \times 100 = 50\%$

$\frac{15}{50} \times 100 = 30\%$

Optional method: - - - - - - - - →

APPENDIX.

6. *How to convert to tighter AQLs.*

Some persons (processors, private label buyers, quality assurance personnel, etc.) have in the past required that production be better than a minimum grade limit as defined in the U.S. standards (such as bottom grade A). These persons developed their own specifications.

With the CuSum plan, a limit may be placed on production so that a minimum grade level is clearly unacceptable. The easiest way to do this is to tighten the specified AQL. The CuSum plan offers this flexibility and also indicates the chances of passing a level of defects worse than the AQL. Also, the selection of the appropriate plan (13, 25, 50, 100 or 200) may reduce the chances of accepting bad quality.

With the CuSum plan, the larger the standard sample unit size, the better the protection against poorer quality. However, there is a "trade-off." Large sample unit sizes increase the time and costs of inspection. The desired protection should be practical.

a. Use as a base of operation, the AQLs that are applicable for the designated grade in the U.S. standards.

Example:

	U.S. GRADE B			
	Total	*Major*	*Severe*	*Critical*
AQL 1/	*20.0*	*10.0*	*2.5*	*0.65*

1/ AQL expressed as defects per 100 units.

APPENDIX.

6. How to convert to tighter AQLs (continuation).

b. Use the standard sample unit size applicable for the product. If the sample unit size is changed, the protection against poorer quality would change. However, the sample unit size may be changed, if desired.

Example:

"§2852.2564 Recommended Sample Unit Sizes.

* * *

Halves; Quarters -- 25 Units"

c. Refer to the appropriate CuSum table that you're using.

Example:

TABLE VII
CUSUM SAMPLING PLANS

STANDARD SAMPLE UNIT SIZE = 25

AQL	*S*	*T*	*L*	*Quality Levels*	
				Pa=50%	*Pa=10%*
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS OR PERCENT DEFECTIVE					
* * *					
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS ONLY					
* * *					
20.0	*1*	*6*	*4*	*29.7*	*42.7*
* * *					

APPENDIX.

6. How to convert to tighter AQLs (continuation).

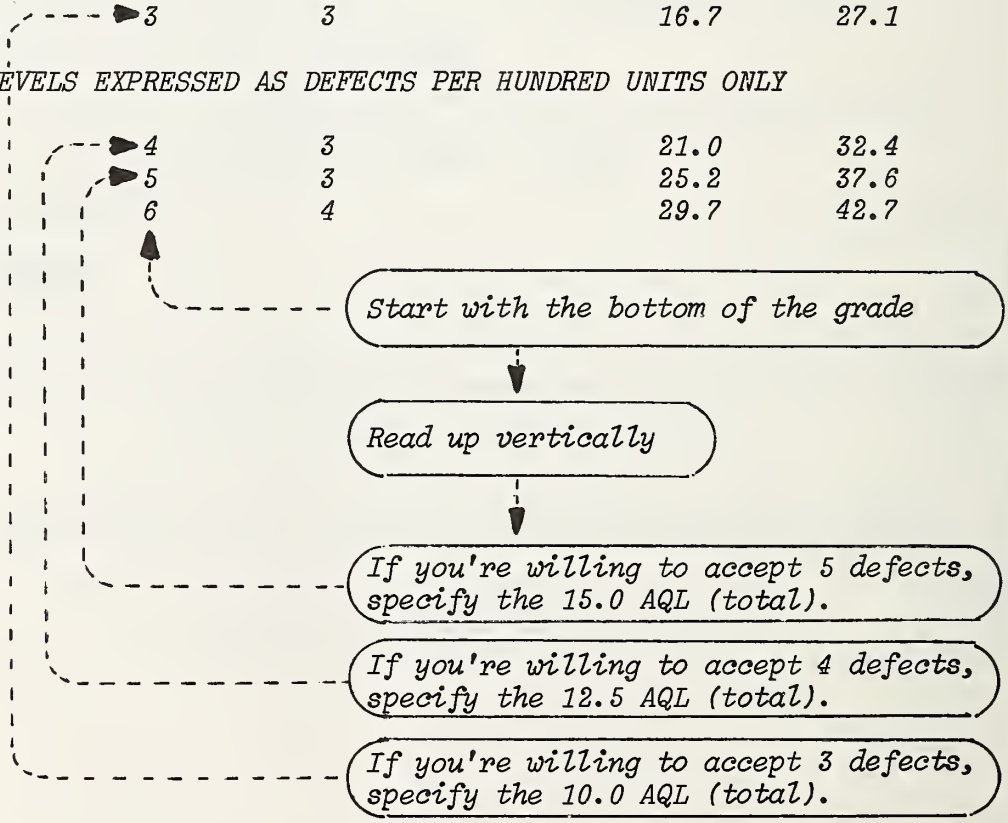
d. Tolerance ("T") method: Use the tolerance ("T") as the number of defects that you're willing to accept.

Example:

TABLE VII
CUSUM SAMPLING PLANS

STANDARD SAMPLE UNIT SIZE = 25

AQL	*S*	*T*	*L*	*Quality Levels* *Pa=50%*	*Pa=10%*
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS OR PERCENT DEFECTIVE					
* * *					
10.0	*1*	*3*	*3*	*16.7*	*27.1*
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS ONLY					
12.5	*1*	*4*	*3*	*21.0*	*32.4*
15.0	*1*	*5*	*3*	*25.2*	*37.6*
20.0	*1*	*6*	*4*	*29.7*	*42.7*
* * *					



APPENDIX.

6. How to convert to tighter AQLs (continuation).

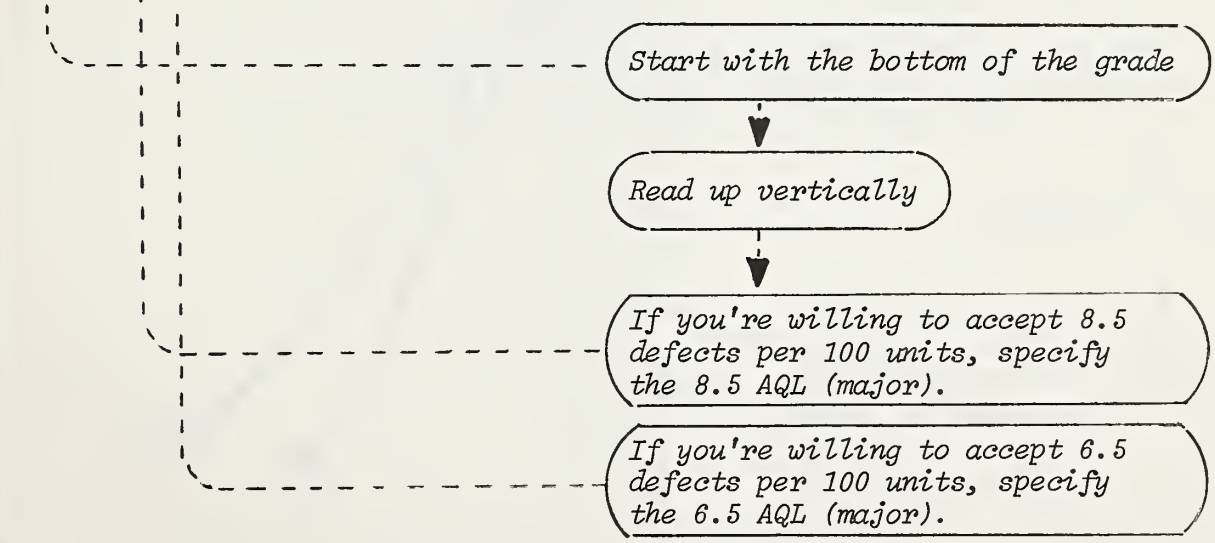
e. AQL method: Use the AQL as the number of defects that you're willing to accept in 100 units.

Example:

TABLE VII
CUSUM SAMPLING PLANS

STANDARD SAMPLE UNIT SIZE = 25

AQL	S	T	L	Quality Levels Pa=50%	Quality Levels Pa=10%
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS OR PERCENT DEFECTIVE					
* * *					
5.0	1.5	1.5	3	9.1	16.3
6.5	1	2	3	12.2	21.5
8.5	0	3	2	16.4	27.1
10.0	1	3	3	16.7	27.1
* * *					



APPENDIX.

6. How to convert to tighter AQLs (continuation).

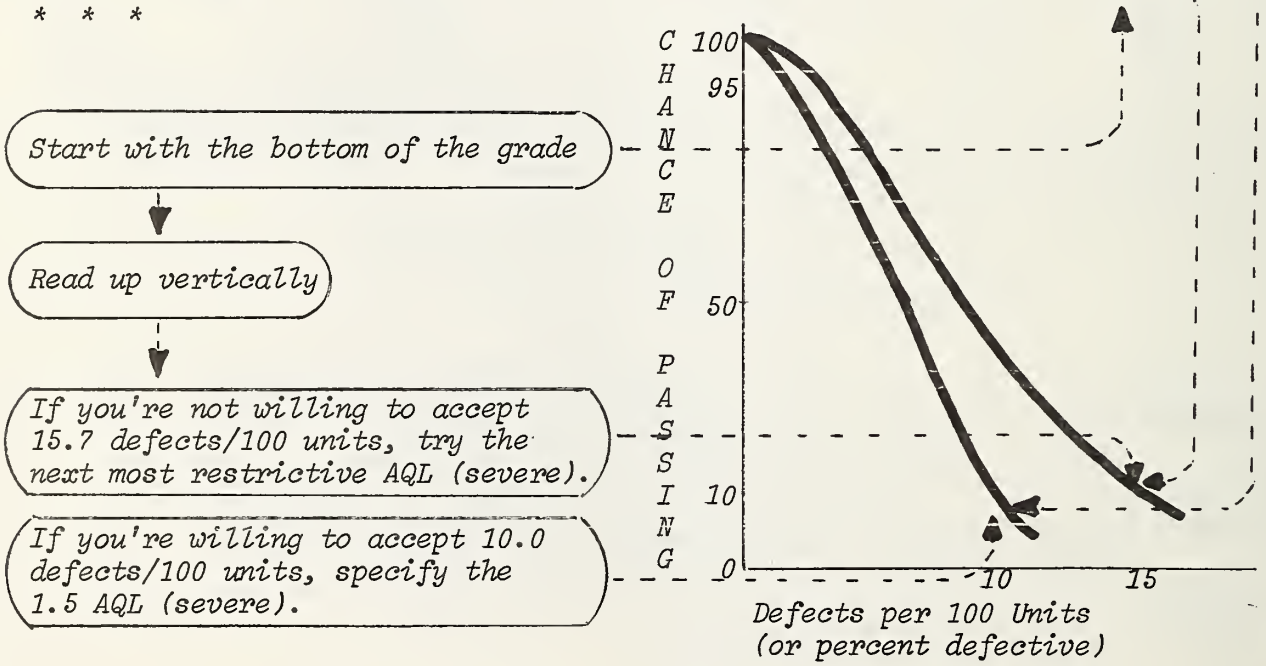
f. Limiting quality method (Pa=10%): Use the Pa=10% as a guide to the worst quality that you're willing to accept.

Example:

TABLE VII
CUSUM SAMPLING PLANS

STANDARD SAMPLE UNIT SIZE = 25

AQL	*S*	*T*	*L*	*Quality Levels* Pa=50%	Pa=10%
QUALITY LEVELS EXPRESSED AS DEFECTS PER HUNDRED UNITS OR PERCENT DEFECTIVE					
* * *					
1.0	*0*	*0.5*	*0.5*	*4.0*	*10.0*
1.5	*1*	*0.5*	*2*	*7.5*	*10.0*
2.5	*0*	*1*	*1*	*9.0*	*15.7*
* * *					

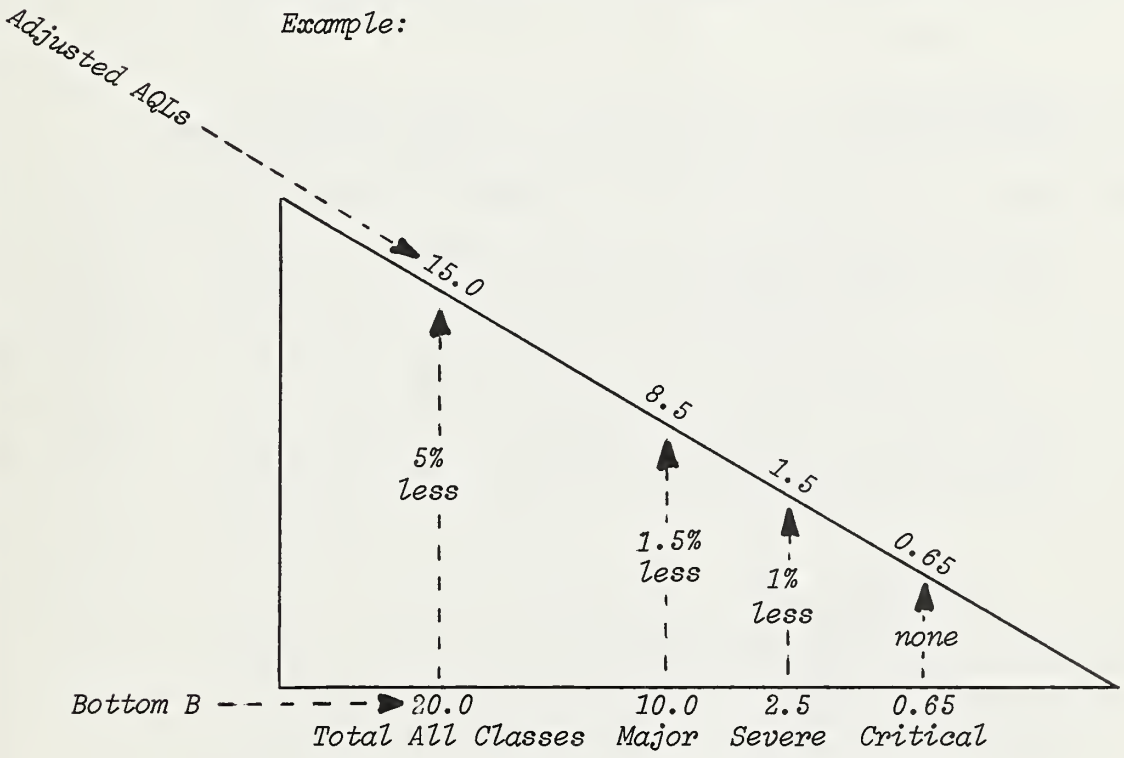


APPENDIX.

6. How to convert to tighter AQLs (continuation).

g. From a practical standpoint, AQLs for the more serious defects (major, severe and critical) should be tightened less than the AQLs for the less serious defects (total all classes).

Example:



APPENDIX.

6. How to convert to tighter AQLs (continuation).

h. If you change the standard sample unit size, the protection against acceptance of poorer quality would also change.

Example:

TABLE VII
CUSUM SAMPLING PLANS

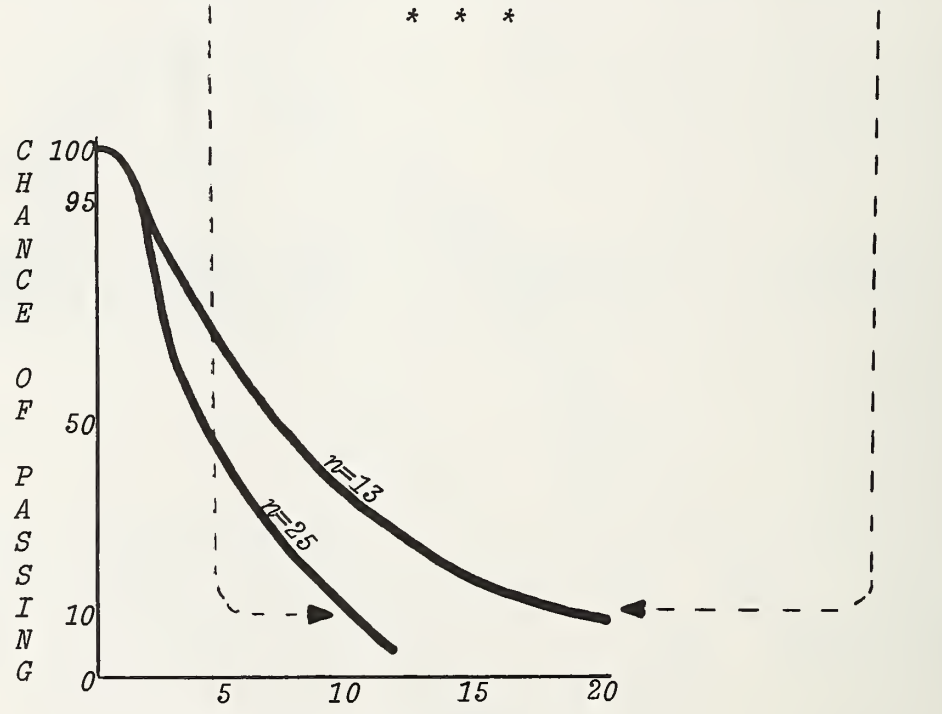
STANDARD SAMPLE UNIT SIZE = 25

AQL	*S*	*T*	*L*	*Pa=50%*	*Pa=10%*
* * *					
1.5	*1*	*0.5*	*2*	*4.3*	*10.0*
* * *					

TABLE VI
CUSUM SAMPLING PLANS

STANDARD SAMPLE UNIT SIZE = 13

AQL	*S*	*T*	*L*	*Pa=50%*	*Pa=10%*
* * *					
1.5	*0*	*0.5*	*0.5*	*7.7*	*19.2*
* * *					



APPENDIX.

7. How to reevaluate a defect tally sheet.

It is possible to reevalute a previously filled in defect tally sheet to determine if past production would meet a specification not used at the time of the original grading. This situation could occur if production was sold several months after packing.

The defect tally sheet is a history of production. It contains the order of production, the number of units examined, the number of classified defects, and the record of prerequisite quality factors.

Normally, a buyer's specification would be expected to place a limitation on specific defects other than what the product was originally graded against.

The defect tally sheet may be reevaluated several different ways -- transpose to a new tally sheet or superimpose on the old tally sheet. If there is any information on the old tally sheet which would reveal another buyer's position, a new tally sheet should be completed.

There is a "trap" in reevaluating a defect tally sheet -- that is failed production. It must be considered because the order of production would influence acceptance or rejection of portions of production. In reevaluating a defect tally sheet, don't bypass failed production even though that production may have been removed from the lot.

The example on the next page of this manual shows the reevaluation of a defect tally sheet by superimposing a buyer's AQLs on the old tally sheet.

APPENDIX.

7. How to reevaluate a defect tally sheet (continuation).

Example: (Designated grade B showing all classes of defects)

Foods, Top B Label: Misses → | Meets →

	Production Code		S	T	L	CYC1 →			CYC2 →		CYC3 →		CYC4 →	
PRE	Overall Color					A	A	A	A	A	A	A	A	A
	Flavor and Odor					A	A	A	A	A	A	A	A	A
	Peel					A	B	A	A	A	A	B	B	A
						25	25	25	25	25	25	25	25	25
CRIT	Pit Material								1					
	Total Critical					0	0	0	1	0	0	0	0	0
	CUSUM 0.65	A	0.3	0.1	0.9	0.3	0.1	0	0.8	0.6	0.4	0.2	0	0
		B	0	0.5	0.5	0	0	0	0.5	0	0	0	0	0
		C	0	1	1									
SEVERE	EVM													
	Off-suture					1			1	1				
	Total Severe					1	0	0	1	1	0	0	0	0
	CUSUM	A	0	0.5	0.5									
		B	0	1	1	0	0	0	0	0	0	0	0	0
		C	0.5	1.5	2									
MAJOR	Color													
	Gouge					1		1	1	1	1	1	1	1
	Total Major					1	0	1	1	1	1	1	1	1
	CUSUM	A	0	1	1									
		B	1.5	1.5	3	1	0	0	0	0	0	0	0	0
		C	0	3	2									
MIN	Short Stems													
	Blemished					1	1	1	4	1	1	1	1	1
	Total Minor					1	1	1	4	1	1	1	1	1
TOTAL	Total All Classes					3	1	2	7	3	2	2	2	2
	CUSUM 6.5	A	1	2	3	2	1	1	3	3	3	3	3	3
		B	1	3	3	1	0	0	3	3	2	1	0	0
		C	1	5	3				C	←				
	Sample Unit Grade					B →			C	B →				
	Production Grade					B →			C →		B →			

NOTE: Two-in-a-row rule, step 3, does not apply to reevaluated tally sheet.

APPENDIX.

8. How to use the verification sampling plans.

It is possible to evaluate a small sample to indicate the reliability of the original evaluation of a larger sample; or, to indicate if there has been a change in quality since the original evaluation; or, to audit another grader.

The advantage of the verification sampling plan is to reduce the time required for regrading -- a small sample could be graded faster than a large sample. Then, if the verification sample indicates the original evaluation is unreliable, other methods could be used to reevaluate the quality of the lot (such as regrading at the full sample size).

As with all sampling plans, the verification sampling plan is subject to sampling risks (or sampling variation).

The purpose of this instruction is to show how to use the verification sampling plan. This instruction does not give guidelines for the circumstances under which the plan may be used.

To use the verification sampling plan, the procedure is as follows:

a. Obtain the original grading record (tally sheet).

Example:

"TALLY SHEET FOR CANNED_____"

APPENDIX.

8. How to use the verification sampling plan (continuation).

b. Determine the standard sample unit size that was used for the original inspection.

Example 1:

"TALLY SHEET FOR CANNED _____ - SAMPLE UNIT SIZE = 25 HALVES"

Example 2:

"TALLY SHEET FOR FROZEN _____ - SAMPLE UNIT SIZE = 1000 g"

c. Determine the defects per 100 units for each class of defects (total, major, severe and critical) that were found in the original inspection.

Example 1: (defects by count)

* * *

25 + 25 + 25 + 25 + 25 + 25 + 25 + 25 = 200

MAJOR	Color						1				1		
	Blemish					1		1	1	1		1	1
	Total Major					1	1	1	1	1	1	1	1
	CUSUM	A	0	1	1								
		B	1.5	1.5	3	1	0.5	0	0	0	0	0	0
		C	0	3	2								

= 8

* * *

8 sample units X 25 units =

200 / 8.00 = *.04* *X 100 = 4 defects/100 units.*

APPENDIX.

8. How to use the verification sampling plan (continuation).

c. Determine the defects per 100 units for each class of defects (total, major, severe and critical) that were found in the original inspection (continuation).

Example 2: (defects by weight/40 g increments)

* * *

MAJOR	*Color*						*1*				*1*		
	Blemish					*1*		*1*	*1*	*1*		*1*	*1*
	Total Major					*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
	CUSUM	*A*	*0*	*1*	*1*								
		B	*1.5*	*1.5*	*3*	*1*	*0.5*	*0*	*0*	*0*	*0*	*0*	*0*
		C	*0*	*3*	*2*								

= 8

* * *

8 sample units X 1000 g =

8000 g / 40 = *200/ 8.00* (.04) *X 100 = 4 defects/100 units.*

Each 40g increment equals 1 defect

Example 3: (defects by weight/8 g increments)

8 sample units X 200 g =

1600 g / 8 = *200/ 8.00* (.04) *X 100 = 4 defects/100 units.*

Each 8g increment equals 1 defect

APPENDIX.

8. How to use the verification sampling plan (continuation).

d. Select the verification sampling plan that matches the appropriate standard sample unit size used for the original inspection. There are 5 tables of verification plans.

Example:

" TABLE I
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 13
VERIFICATION SAMPLE SIZE = 6 X 13 "

" TABLE II
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 25
VERIFICATION SAMPLE SIZE = 6 X 13 "

" TABLE III
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 50
VERIFICATION SAMPLE SIZE = 6 X 25 "

" TABLE IV
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 100
VERIFICATION SAMPLE SIZE = 6 X 50 "

" TABLE V
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 200
VERIFICATION SAMPLE SIZE = 6 X 100"

APPENDIX.

8. How to use the verification sampling plan (continuation).

e. Perform the inspection of the verification sample that you've drawn. Evaluate all prerequisite quality factors and all classified quality factors (total, major, severe and critical).

f. Check the defects per 100 units that were found in the original inspection against the number of defects you've found in the verification sample for all classes of defects (total, major, severe and critical).

Example:

Original inspection:

25 + 25 + 25 + 25 + 25 + 25 + 25 + 25

MAJOR	Color					1				1			
	Blemish				1		1	1	1		1	1	
	Total Major				1	1	1	1	1	1	1	1	=4/100
	CUSUM A	0	1	1									
	CUSUM B	1.5	1.5	3	1	0.5	0	0	0	0	0	0	
	CUSUM C	0	3	2									

Verification inspection:

13 + 13 + 13 + 13 + 13 + 13

MAJOR	Color						1		1				
	Blemish				1	1		1					
	Total Major				1	1	1	1	1	0			=5
	CUSUM A	0	1	1									
	CUSUM B	1.5	1.5	3									
	CUSUM C	0	3	2									

APPENDIX.

8. How to use the verification sampling plan (continuation).

g. Accept or reject the verification sample based on the results of the check between the original inspection and the verification sample.

Example:

Original inspection:

MAJOR	Color					1				1			
	Blemished				1		1	1	1		1	1	
	Total Major				1	1	1	1	1	1	1	1	= (4/100)
	CUSUM A	0	1	1									
	CUSUM B	1.5	1.5	3	1	0.5	0	0	0	0	0	0	
	CUSUM C	0	3	2									

TABLE II
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 25
VERIFICATION SAMPLE SIZE = 6 X 13

DEFECTS/100 UNITS IN ON-LINE SAMPLE	MAXIMUM NUMBER OF DEFECTS IN VERIFICATION SAMPLE
0.00 - 0.2	1
0.21 - 0.7	2
0.71 - 1.2	3
1.21 - 1.9	4
1.91 - 2.7	5
2.71 - 3.6	6
(3.61 - 4.4)	(7)

(meets)

Verification inspection:

MAJOR	Color						1		1				
	Blemished				1	1		1					
	Total Major				1	1	1	1	1	0			= (5)
	CUSUM A	0	1	1									
	CUSUM B	1.5	1.5	3									
	CUSUM C	0	3	2									

TABLE I
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 13
VERIFICATION SAMPLE SIZE = 6 X 13

DEFECTS/100 UNITS IN ON-LINE SAMPLE	MAXIMUM NO. OF DEFECTS IN VERIFICATION SAMPLE
0.00 - 0.5	2
0.51 - 0.9	3
0.91 - 1.7	4
1.71 - 2.4	5
2.41 - 3.1	6
3.11 - 3.8	7
3.81 - 4.8	8
4.81 - 5.6	9
5.61 - 6.5	10
6.51 - 7.4	11
7.41 - 8.2	12
8.21 - 9.2	13
9.21 - 10.0	14
10.01 - 11.0	15
11.01 - 12.0	16
12.01 - 13.0	17
13.01 - 14.0	18
14.01 - 15.0	19
15.01 - 16.0	20
16.01 - 17.0	21
17.01 - 18.0	22
18.01 - 19.0	23
19.01 - 20.0	24
20.01 - 21.0	25
21.01 - 22.0	26
22.01 - 23.0	27
23.01 - 24.0	28
24.01 - 25.0	29
25.01 - 26.0	30
26.01 - 27.0	31
27.01 - 28.0	32
28.01 - 29.0	33
29.01 - 31.0	34
31.01 - 33.0	36
33.01 - 35.0	38
35.01 - 37.0	40
37.01 - 39.2	42
39.21 - 42.0	44
42.01 - 43.0	46
43.01 - 45.7	48
45.71 - 48.0	50
48.01 - 50.0	52
50.01 - 52.5	54
52.51 - 55.0	56
55.01 - 57.0	58
57.01 - 59.0	60
59.01 - 61.0	62
61.01 - 64.0	64
64.01 - 66.0	66
66.01 - 68.0	68
68.01 - 70.0	70
70.01 - 73.0	72
73.01 - 75.0	74
75.01 - 77.0	76
77.01 - 80.0	78
80.01 - 83.0	81
83.01 - 87.0	84
87.01 - 90.0	87
90.01 - 94.0	90
94.01 - 97.0	93
97.01 - 100.0	96
100.01 - 104.0	99
104.01 - 107.0	102
107.01 - 111.0	105
111.01 - 114.0	108
114.01 - 118.0	111
118.01 - 121.0	114
121.01 - 125.0	117
125.01 - 128.0	120
128.01 - 132.5	123
132.51 - 137.0	127
137.01 - 141.5	131
141.51 - 146.5	135
146.51 - 151.0	139
151.01 - 156.0	143
156.01 - 160.0	147
160.01 - 165.0	151
165.01 - 170.0	155
170.01 - 174.0	159
174.01 - 179.0	163
179.01 - 184.0	167
184.01 - 188.0	171
188.01 - 193.5	175
193.51 - 198.0	179
198.01 - 203.0	183
203.01 - 207.0	187
207.01 - 213.0	191
213.01 - 217.5	195
217.51 - 222.0	199
222.01 - 226.1	203
226.11 - 232.0	207
232.01 - 237.0	212
237.01 - 242.0	216
242.01 - 247.0	220
247.01 - 251.0	224
251.01 - 257.0	228
257.01 - 263.0	233
263.01 - 268.0	238
268.01 - 274.9	243
274.91 - 281.0	248
281.01 - 288.0	253
288.01 - 293.5	259
293.51 - 300.0	264
300.01 - 306.0	269

TABLE II
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 25
VERIFICATION SAMPLE SIZE = 6 X 13

DEFECTS/100 UNITS IN ON-LINE SAMPLE	MAXIMUM NO. OF DEFECTS IN VERIFICATION SAMPLE
0.00 - 0.2	1
0.21 - 0.7	2
0.71 - 1.2	3
1.21 - 1.9	4
1.91 - 2.7	5
2.71 - 3.6	6
3.61 - 4.4	7
4.41 - 5.3	8
5.31 - 6.1	9
6.11 - 7.1	10
7.11 - 7.9	11
7.91 - 8.9	12
8.91 - 9.9	13
9.91 - 10.8	14
10.81 - 11.5	15
11.51 - 12.8	16
12.81 - 13.5	17
13.51 - 15.0	18
15.01 - 15.5	19
15.51 - 17.0	20
17.01 - 17.5	21
17.51 - 19.0	22
19.01 - 20.0	23
20.01 - 21.0	24
21.01 - 22.0	25
22.01 - 23.0	26
23.01 - 24.0	27
24.01 - 25.0	28
25.01 - 26.0	29
26.01 - 27.0	30
27.01 - 28.5	31
28.51 - 29.0	32
29.01 - 30.9	33
30.91 - 33.0	35
33.01 - 35.0	37
35.01 - 37.5	39
37.51 - 39.8	41
39.81 - 42.0	43
42.01 - 44.0	45
44.01 - 46.0	47
46.01 - 48.8	49
48.81 - 50.2	51
50.21 - 53.0	53
53.01 - 55.0	55
55.01 - 58.0	57
58.01 - 61.0	60
61.01 - 64.9	63
64.91 - 68.0	66
68.01 - 71.2	69
71.21 - 75.0	72
75.01 - 78.0	75
78.01 - 81.9	78
81.91 - 85.0	81
85.01 - 88.9	84
88.91 - 92.0	87
92.01 - 96.0	90
96.01 - 99.0	93
99.01 - 103.0	96
103.01 - 106.0	99
106.01 - 110.0	102
110.01 - 113.0	105
113.01 - 117.0	108
117.01 - 122.0	112
122.01 - 126.0	116
126.01 - 131.0	120

TABLE III
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 50
VERIFICATION SAMPLE SIZE = 6 X 25

DEFECTS/100 UNITS IN ON-LINE SAMPLE	MAXIMUM NO. OF DEFECTS IN VERIFICATION SAMPLE
0.00 - 0.1	1
0.11 - 0.35	2
0.36 - 0.65	3
0.66 - 1.05	4
1.06 - 1.45	5
1.46 - 1.9	6
1.91 - 2.3	7
2.31 - 2.7	8
2.71 - 3.2	9
3.21 - 3.7	10
3.71 - 4.1	11
4.11 - 4.7	12
4.71 - 5.1	13
5.11 - 5.7	14
5.71 - 6.1	15
6.11 - 6.7	16
6.71 - 7.2	17
7.21 - 7.7	18
7.71 - 8.3	19
8.31 - 8.8	20
8.81 - 9.3	21
9.31 - 9.9	22
9.91 - 10.3	23
10.31 - 11.0	24
11.01 - 11.5	25
11.51 - 12.0	26
12.01 - 12.5	27
12.51 - 13.0	28
13.01 - 13.5	29
13.51 - 14.4	30
14.41 - 15.5	32
15.51 - 16.6	34
16.61 - 17.8	36
17.81 - 18.9	38
18.91 - 20.0	40
20.01 - 21.1	42
21.11 - 22.4	44
22.41 - 23.5	46
23.51 - 24.5	48
24.51 - 26.0	50
26.01 - 27.0	52
27.01 - 28.0	54
28.01 - 29.0	56
29.01 - 30.6	58
30.61 - 32.0	60
32.01 - 33.7	63
33.71 - 35.4	66
35.41 - 37.0	69
37.01 - 39.0	72
39.01 - 40.8	75
40.81 - 42.4	78
42.41 - 44.5	81
44.51 - 46.0	84
46.01 - 48.0	87
48.01 - 49.8	90
49.81 - 52.0	93
52.01 - 54.0	97
54.01 - 56.6	101
56.61 - 59.0	105
59.01 - 61.5	109
61.51 - 64.0	113
64.01 - 66.0	117
66.01 - 69.0	121
69.01 - 71.0	125
71.01 - 73.5	129
73.51 - 76.0	133
76.01 - 79.0	137
79.01 - 82.0	142
82.01 - 85.0	147
85.01 - 88.0	152
88.01 - 91.0	157
91.01 - 94.0	162
94.01 - 98.0	167
98.01 - 101.0	173
101.01 - 105.0	179

TABLE IV
VERIFICATION SAMPLING PLANS
ON-LINE SAMPLE UNIT SIZE = 100
VERIFICATION SAMPLE SIZE = 6 X 50

DEFECTS/100 UNITS IN ON-LINE SAMPLE	MAXIMUM NO. OF DEFECTS IN VERIFICATION SAMPLE
0.00 - 0.05	1
0.06 - 0.17	2
0.18 - 0.33	3
0.34 - 0.5	4
0.51 - 0.7	5
0.71 - 0.95	6
0.96 - 1.15	7
1.16 - 1.35	8
1.36 - 1.6	9
1.61 - 1.8	10
1.81 - 2.1	11
2.11 - 2.3	12
2.31 - 2.6	13
2.61 - 2.8	14
2.81 - 3.1	15
3.11 - 3.3	16
3.31 - 3.6	17
3.61 - 3.9	18
3.91 - 4.1	19
4.11 - 4.4	20
4.41 - 4.7	21
4.71 - 4.9	22
4.91 - 5.2	23
5.21 - 5.5	24
5.51 - 5.7	25
5.71 - 6.0	26
6.01 - 6.3	27
6.31 - 6.6	28
6.61 - 6.8	29
6.81 - 7.1	30
7.11 - 7.4	31
7.41 - 7.7	32
7.71 - 7.9	33
7.91 - 8.3	34
8.31 - 8.9	36
8.91 - 9.4	38
9.41 - 10.0	40
10.01 - 10.6	42
10.61 - 11.2	44
11.21 - 11.7	46
11.71 - 12.5	48
12.51 - 13.3	51
13.31 - 14.0	54
14.01 - 14.5	56
14.51 - 15.3	58
15.31 - 16.0	60
16.01 - 16.8	63
16.81 - 17.7	66
17.71 - 18.5	69
18.51 - 19.5	72
19.51 - 20.3	75
20.31 - 21.2	78
21.21 - 22.2	81
22.21 - 23.0	84
23.01 - 24.0	87
24.01 - 24.8	90
24.81 - 25.7	93
25.71 - 26.8	96
26.81 - 28.0	100
28.01 - 29.2	104
29.21 - 30.4	108
30.41 - 31.7	112
31.71 - 32.8	116
32.81 - 34.0	120
34.01 - 35.5	124
35.51 - 36.8	128
36.81 - 38.2	133
38.21 - 39.7	138
39.71 - 41.0	143
41.01 - 42.5	147
42.51 - 43.8	151
43.81 - 45.0	156
45.01 - 46.6	160
46.61 - 48.0	165
48.01 - 49.5	170
49.51 - 51.2	175
51.21 - 52.7	180
52.71 - 54.0	185
54.01 - 55.8	190
55.81 - 57.3	195
57.31 - 59.0	200
59.01 - 60.4	205
60.41 - 62.0	210
62.01 - 63.8	215
63.81 - 65.2	220
65.21 - 66.8	225

TABLE V
VERIFICATION SAMPLING PLAN
ON-LINE SAMPLE UNIT SIZE = 200
VERIFICATION SAMPLE UNIT SIZE = 6 X 100

DEFECTS/100 UNITS IN ON-LINE SAMPLE	MAXIMUM NO. OF DEFECTS IN VERIFICATION SAMPLE
0.00 - 0.025	1
0.026 - 0.09	2
0.091 - 0.165	3
0.166 - 0.255	4
0.256 - 0.36	5
0.361 - 0.45	6
0.46 - 0.55	7
0.56 - 0.7	8
0.71 - 0.8	9
0.81 - 0.9	10
0.91 - 1.05	11
1.06 - 1.15	12
1.16 - 1.3	13
1.31 - 1.4	14
1.41 - 1.5	15
1.51 - 1.7	16
1.71 - 1.8	17
1.81 - 1.9	18
1.91 - 2.1	19
2.11 - 2.2	20
2.21 - 2.3	21
2.31 - 2.45	22
2.46 - 2.6	23
2.61 - 2.7	24
2.71 - 2.9	25
2.91 - 3.0	26
3.01 - 3.1	27
3.11 - 3.3	28
3.31 - 3.4	29
3.41 - 3.6	30
3.61 - 3.7	31
3.71 - 3.8	32
3.81 - 4.0	33
4.01 - 4.3	35
4.31 - 4.6	37
4.61 - 4.9	39
4.91 - 5.2	41
5.21 - 5.4	43
5.41 - 5.8	45
5.81 - 6.0	47
6.01 - 6.3	49
6.31 - 6.6	51
6.61 - 6.9	53
6.91 - 7.2	55
7.21 - 7.5	57
7.51 - 7.8	59
7.81 - 8.1	61
8.11 - 8.6	64
8.61 - 9.0	67
9.01 - 9.4	70
9.41 - 9.9	73
9.91 - 10.3	76
10.31 - 10.8	79
10.81 - 11.2	82
11.21 - 11.7	85
11.71 - 12.2	88
12.21 - 12.6	91
12.61 - 13.1	94
13.11 - 13.5	97
13.51 - 14.0	100
14.01 - 14.6	104
14.61 - 15.2	108
15.21 - 15.8	112
15.81 - 16.4	116
16.41 - 17.0	120
17.01 - 17.7	124
17.71 - 18.3	128
18.31 - 19.0	133
19.01 - 19.7	138
19.71 - 20.5	143
20.51 - 21.2	147
21.21 - 21.9	151
21.91 - 22.5	156
22.51 - 23.3	160
23.31 - 24.0	165
24.01 - 24.8	170
24.81 - 25.6	175
25.61 - 26.4	180
26.41 - 27.0	185
27.01 - 27.9	190
27.91 - 28.6	195
28.61 - 29.4	200
29.41 - 30.2	205
30.21 - 31.0	210
31.01 - 31.8	215
31.81 - 32.5	220
32.51 - 33.4	225
33.41 - 34.2	231
34.21 - 35.2	236
35.21 - 36.0	241
36.01 - 36.6	246
36.61 - 37.4	251
37.41 - 38.3	256
38.31 - 39.0	262
39.01 - 39.9	267
39.91 - 40.7	272
40.71 - 41.6	277
41.61 - 42.2	282
42.21 - 43.0	287
43.01 - 44.0	292
44.01 - 44.7	298
44.71 - 45.8	304
45.81 - 47.0	311
47.01 - 48.2	318
48.21 - 49.0	325
49.01 - 50.3	332
50.31 - 51.4	339
51.41 - 52.5	346
52.51 - 53.6	354
53.61 - 54.9	361
54.91 - 56.2	368
56.21 - 57.3	376
57.31 - 58.8	384
58.81 - 60.0	393
60.01 - 61.4	401
61.41 - 63.0	410
63.01 - 64.0	420
64.01 - 65.0	428
65.01 - 66.0	436

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